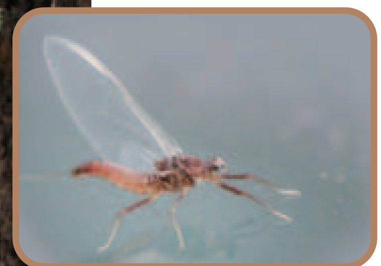
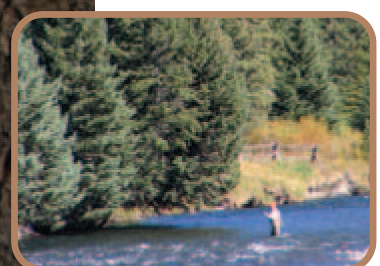
Draft Environmental Impact Statement for the Gallatin River Outstanding Resource Water Designation





Montana Department of Environmental Quality
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September 2006

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Prepared for:

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September 8, 2006

Montana Department of
ENVIRONMENTAL QUALITY

Brian Schweitzer, Governor

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September 2006

Dear Reader:

Enclosed for your review and comment is the Draft Environmental Impact Statement (EIS) for the Gallatin River Outstanding Resource Water Designation.

In December 2001, the Montana Board of Environmental Review (BER) received a petition to designate the Gallatin River as an outstanding resource water (ORW) from the Yellowstone National Park boundary to Spanish Creek. At its March 2002 meeting, the BER ordered the Montana Department of Environmental Quality (DEQ) to prepare an EIS to disclose the potential impacts of ORW designation.

Under the Proposed Action, the BER would draft a rule for the Administrative Rules of Montana designating the river an ORW. The legislature would have to approve legislation to implement the rule. The Draft EIS analyzes the potential impacts of the proposed action as well as the potential impacts of alternatives: 1) the No Action Alternative (not designating the Gallatin River an ORW); and 2) the Cumulative Impacts Analysis Alternative (not designating the river an ORW but exercising DEQ's discretion to consider the cumulative impacts of pollutant sources). The Draft EIS addresses issues and concerns raised during the public scoping period of November 25, 2005, to December 28, 2005, and during the public scoping meeting held in Gallatin Gateway on December 12, 2005.

Public comments concerning the adequacy and accuracy of the Draft EIS will be accepted until October 27, 2006. Written comments may be sent to the Montana Department of Environmental Quality, Director's Office, PO Box 200901, Helena, MT 59620-0901, attn: Greg Hallsten.

A public hearing to receive verbal and written comments will be held during the comment period. Hearing details will be announced through area media.

The Final EIS might only contain public comments and responses and changes to the Draft EIS. Please keep this Draft EIS for future reference.

Richard H. Opper, Director
State of Montana
Department of Environmental Quality

Executive Summary

Introduction

This draft Environmental Impact Statement (DEIS) has been prepared to assess the impacts of designating a reach of the Gallatin River as an Outstanding Resource Water (ORW). In 1995 Montana passed legislation allowing such designation, and in 2001 the Montana Board of Environmental Review (Board) was petitioned to consider designating the reach of the Gallatin River from the Yellowstone National Park boundary downstream to the river's confluence with Spanish Creek (Figure 1), as Montana's first ORW outside of a national park or wilderness. The geographic scope of this EIS includes the ORW reach and lands around the ORW which have a hydrologic connection to this reach. The ORW designation would protect water quality in the reach by prohibiting certain actions that would decrease its current level of quality. Upon review of this EIS, the Board may initiate rulemaking to classify the specified reach of the Gallatin River as an ORW; however, the designation as an ORW will not become effective until the Montana State Legislature votes to approve it.

Purpose and Benefits of the Proposed Action

The purpose and benefit of the proposed action is to protect existing water quality in the ORW reach of the Gallatin River. Under ORW status the DEQ could not grant an authorization to degrade water quality, nor could it allow a new or increased point source discharge that resulted in a permanent change in the water quality of the ORW reach. The petitioner believes that this level of protection is necessary due to the current high water quality, and due to potential sources of degradation. Six of the nine major tributaries in the upper Gallatin River drainage are currently listed as having impaired water quality. Further, the Montana Water Quality Act allows users to apply for discharges that may result in degradation of existing water quality. Finally, county zoning and DEQ regulations (including point source nondegradation reviews) allow for incremental reductions in water quality. Thus, the petitioner held that ORW status is the only regulation that would allow for protection of the ORW reach by preserving the current high quality of water in the proposed ORW reach. The Board will review this DEIS and determine whether it agrees with the petitioner on this count.

Alternatives Description

Several alternatives are considered in this DEIS, and some were eliminated from further consideration. The alternatives fully evaluated in the DEIS are the No Action Alternative, the Proposed Action Alternative (ORW designation,) and the Cumulative Impacts Analysis Alternative, under which DEQ would exercise existing authority to evaluate cumulative impacts to water quality.

No Action Alternative

Under the No Action Alternative, the Board would not initiate rule making and ORW designation would not proceed. Current water quality laws would remain in force and there would be no changes to DEQ's water quality management in the proposed ORW reach. DEQ could issue authorizations to degrade, and permits for new and increased point source discharge.

Narrative water quality standards could be used in lieu of numeric standards. Water quality could be allowed to degrade to current state standards, but could not exceed those standards.

Proposed Action Alternative: Outstanding Resource Water Designation

Under the Proposed Action Alternative, the Gallatin River would be designated an ORW from the Yellowstone National Park boundary to the river's confluence with Spanish Creek. Under this designation DEQ could not allow any activity that caused any permanent change to water quality within this reach. DEQ could not issue any authorizations to degrade.

To implement the Proposed Action Alternative DEQ developed a footprint, a map of land areas that have a direct hydrologic connection to the surface waters of the proposed ORW reach. Any planned developments that would discharge wastewater to ground or surface water within the footprint would have to pass water quality reviews showing that their impacts, when reviewed cumulatively with other discharges, would be below numeric trigger values for water quality standards. No narrative water quality standard would be used. The two trigger values most relevant to development and water quality in the proposed ORW reach are measures of phosphorus and nitrogen/nitrate. If conventional methods of wastewater treatment for a development did not meet ORW limits, then alternative methods of wastewater treatment would need to be used for development to proceed. All developments would be held to the same standards in terms of allowable wastewater nutrient discharges. Under the Proposed Action Alternative each development that contributed to the allowable nutrient load to the Gallatin River would reduce the remaining load. Therefore, later developments may have to meet stricter wastewater discharge concentration criteria.

Cumulative Impacts Analysis Alternative

Under the Cumulative Impacts Analysis Alternative, DEQ would exercise its discretion to evaluate the impact of developments to surface water quality when added to those of other past and pending permits. Although DEQ has the authority to perform this kind nondegradation review, its current policy is to evaluate each development independently. Similar to the Proposed Action Alternative, this alternative would use the footprint, which indicates which lands have a direct hydrologic connection to the surface waters of the Gallatin River. However, under this alternative, if a development did not meet the nondegradation standards, the owner could apply for an authorization to degrade, and could request use of a narrative water quality standard, two options which are not available under the Proposed Action Alternative. DEQ could rescind its use of the cumulative impacts analysis at any time, without public review or comment. Under the Cumulative Impacts Analysis Alternative each development that contributed to the allowable nutrient load to the Gallatin River would reduce the remaining load. Therefore, later developments may have to meet stricter wastewater discharge concentration criteria.

Alternative Considered and Eliminated

Several alternatives were initially considered, but not fully analyzed in the DEIS as they are not reasonable or feasible, or do not meet the purpose and benefit of the Proposed Action. Designating the Gallatin River as a Wild and Scenic River was considered, however, this federal designation only protects water quantity, and does not protect water quality. Consideration was also given to developing trigger values for water quality for five sub-watersheds within the Gallatin ORW. However, development of such water quality sub-watershed values would require

difficult mathematical modeling and would create regulatory confusion among agencies. Another alternative considered and dismissed would be to divide up the pollutant load into values applicable to each single family equivalent, and then limit housing and commercial development. However, this alternative was dismissed as impractical since DEQ does not have the authority to implement zoning or regulate development.

Affected Environment

The affected environment section provides a baseline of information from which to analyze and compare the effects of the various alternatives. The dominant hydrologic feature in the Upper Gallatin Valley is the Gallatin River and its tributaries. The mainstem Gallatin River is generally broad, meandering and low gradient, while the tributaries are steeper, straighter and narrower. Nine major tributaries flow into the proposed ORW reach, including Spanish Creek which delineates the downstream end of the proposed ORW reach. US Highway 191 encroaches on the river in several places in the proposed ORW reach, and crosses it three times. Soils near the proposed ORW reach vary in permeability, and average moderate permeability.

Historic development in and around Big Sky has affected water quality via increased nutrients (nitrates and phosphorus) through wastewater discharges, construction activities, and other sources. Algal growth in the river indicates input of nutrients from the West Fork into the mainstem Gallatin River. Six tributaries to the proposed ORW reach have had recent TMDL assessments, and are listed as impaired for some of their beneficial uses. Water quality in the mainstem is generally very good with some nitrate enrichment.

Most of the land along the river is in public ownership, largely under federal management by the Gallatin National Forest. Private land ownership is concentrated near Big Sky, with some private ownership along the Gallatin River and US Highway 191. The primary recreational uses of the proposed ORW reach are fishing, and commercial and recreational rafting and kayaking. The Gallatin River is known as a ‘blue-ribbon’ trout fishery. Rainbow trout dominate, while brown trout are more limited; other fish common in the river are mountain whitefish, two species of sucker, and a sculpin. There are no known cultural sites that overlap the proposed ORW reach, although the surrounding area has several documented cultural sites.

Over half the housing in and around Big Sky is leisure-oriented or seasonally occupied. One out of three people in Big Sky and West Yellowstone are directly employed in tourism. The current net economic value of the recreational fishery and commercial rafting in the proposed ORW reach are estimated at $3.8 and $4.6 million per year, respectively.

The vegetation along the Gallatin River is dominated by coniferous forest, grasslands, shrubland, and riparian vegetation. A number of big game species frequent the area including moose, elk, mule deer, whitetail deer, and bighorn sheep. The riparian vegetation is used by songbirds, including neotropical migrants, and by raptors and waterfowl.

Comparison of Alternatives and Impacts

This DEIS evaluates the Proposed Action (ORW designation), the No Action, and the Cumulative Impacts Analysis alternatives. This DEIS differs from others in that it evaluates a

regulatory action; thus the Proposed Action Alternative analyzes the impacts of maintaining the existing water quality conditions in the Gallatin River. The No Action Alternative analyzes the impacts of maintaining the existing regulatory environment. The Cumulative Impacts Analysis Alternative analyzes the impacts of DEQ exercising its discretion to review cumulative impacts of multiple developments on the ORW reach. Table 1 displays an annotated comparison of impacts across all alternatives and all resource areas.

No Action Alternative

Under the No Action Alternative, residential and commercial development could proceed along the proposed ORW reach, with water quality regulated under existing law and rules. The current non-degradation rules of DEQ would apply (both numeric and narrative limits) and water quality in the ORW reach would be allowed to deteriorate in incremental amounts.

Land use analysis shows there are approximately 652 developable units left within the footprint area of the ORW. For purposes of water quality permitting, the Gallatin River mainstem could be considered a mixing zone, and loading of nitrate and phosphorus in soils due to septic systems would increase. However, analysis shows that exceedance of the phosphorus trigger value in the Gallatin River mainstem would occur well before full build-out in the footprint. This nutrient enrichment would likely contribute to more algal growth. Algal growth and nutrient level increases could contribute to changes in the macroinvertebrate communities, decreases in recreational value, and lower angler catch or satisfaction. Further, changes in the macroinvertebrate community could lead to slower fish growth and a decreased angling experience in the Gallatin River.

Proposed Action Alternative: Outstanding Resource Water Designation

Under the Proposed Action Alternative, DEQ could not permit actions that would permanently degrade water quality. This regulation would limit the development that could occur within the footprint that used traditional wastewater treatment systems (septic systems and drainfields). However, with mitigation, such as the use of alternative wastewater treatment systems, including advanced subsurface treatment (recirculating sand filters, chemical removal, and composting or incinerator toilets), zero discharge options (off-site disposal), or centralized treatment options, development within the footprint could proceed at higher levels up to full build-out. These alternative wastewater treatment systems would add on average less than 1% to the cost of a lot and home in the area surrounding the proposed ORW reach.

Nutrient loading in the soils would be limited within the developable lands in the footprint. Without mitigation, approximately 67 residences (Single Family Equivalents) could be built within the footprint before the phosphorus trigger value in the Gallatin River was reached.

Cumulative Impacts Analysis Alternative

The impacts of the Cumulative Impacts Analysis Alternative would be similar to those under the Proposed Action Alternative. Limited loading of nutrients to soils in the footprint would be allowed. Each successive development would have to show that its input to the river would not exceed trigger values when combined with inputs from existing and concurrent developments. As the area became more developed and the nutrient level in the river approached trigger values, passing cumulative impact nondegradation analysis would become more and more difficult using

a conventional wastewater treatment system. In essence, this alternative would create a ‘first come, first served’ situation where development shortly after implementation would undergo little or no additional restrictions, but eventually the phosphorus load in the river would approach trigger values. Thereafter, developments would be restricted or would need to discharge outside of the footprint area. This alternative might thus create a rush of development as developers try to get projects approved before the trigger values for nutrients in the ORW are approached. The trigger values are the same under all alternatives; therefore, under this alternative as under the Proposed Action Alternative, approximately 67 SFEs could be built in the footprint before trigger values would be reached.

Secondary and cumulative impacts to water quality, aquatic resources, fisheries and recreation are similar under this alternative to those under the Proposed Action Alternative. This alternative differs from the Proposed Action Alternative in that its protection of water quality in the mainstem Gallatin River is less certain, due to the administrative rather than legislative nature of the protection.

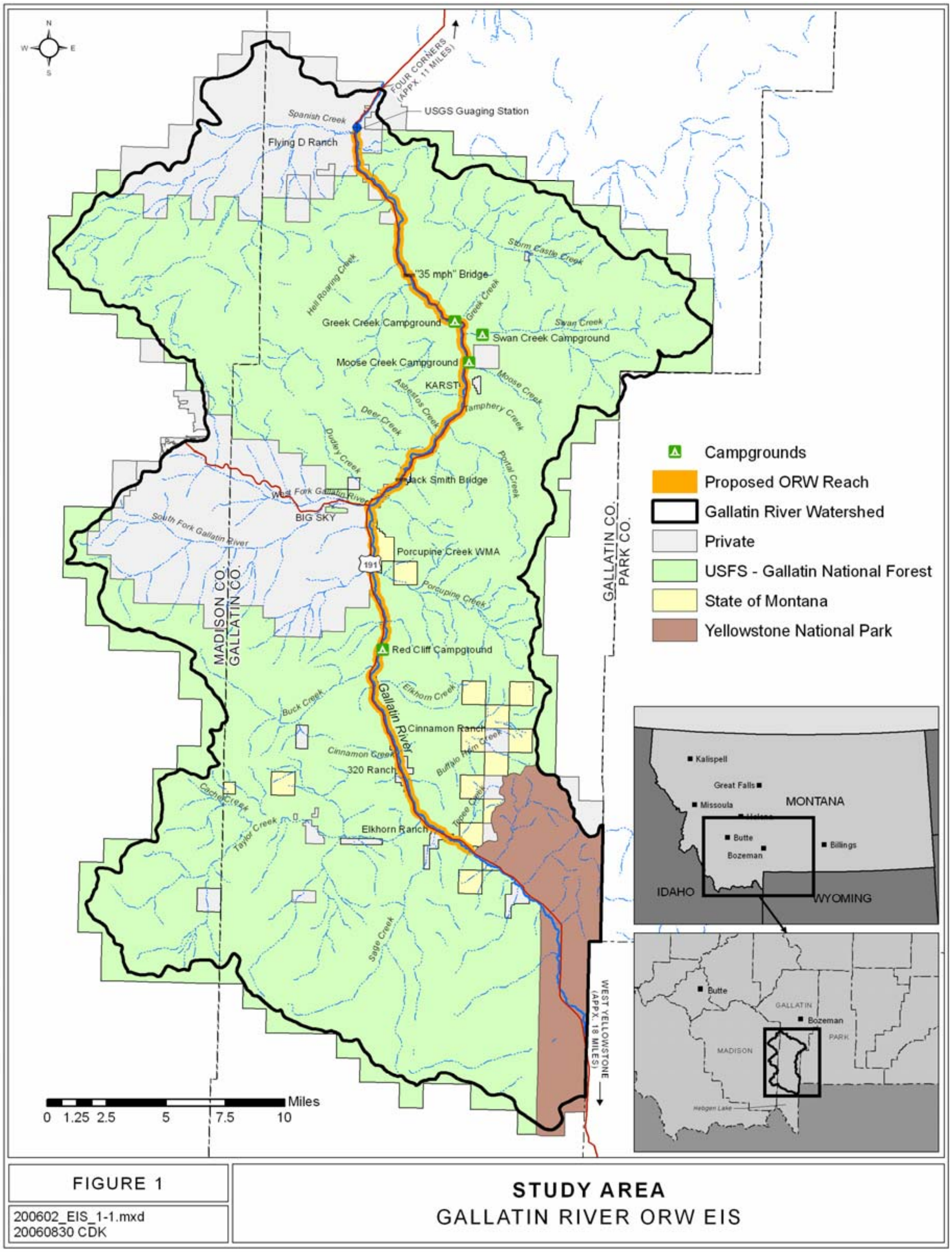

Figure E-1. Study area for the proposed Outstanding Resource Water reach of the Gallatin River in Gallatin and Madison counties, Montana.

Table E-1. Condensed description of potential impacts related to the three alternatives considered in detail in the Gallatin River Outstanding Resource Water Designation Draft Environmental Impact Statement.

Potential Impact **(PI) = Primary** **(SI) = Secondary** **(CI) = Cumulative**	**Common to All Action Alternatives**	**Alternative 1: No Action**	**Alternative 1: No Action with Mitigation Measures**	**Alternative 2: Proposed Action**	**Alternative 2: Proposed Action with Mitigation Measures**	**Alternative 3: Cumulative Impacts Analysis**	**Alternative 3: Cumulative Impacts Analysis with Mitigation Measures**
Hydrology							
Water quality - general	**(PI)**: Water quality standards remain same.	**(PI):** Nondegradation standards for phosphorus and nitrogen remain numeric and narrative. Water quality regulated under the existing rules of DEQ and counties. Local governments required comply with nondegradation requirements that are not part of State's review. Additional nutrient loading to Gallatin River from future build-out. Probable measurable change in water quality.		**(SI):** Change from recently documented trend degrading water quality to stabilized level. Limit amount phosphorus & nitrogen entering the river; prevent permanent, measurable degradation water quality. **(SI):** Stabilization of, or even improvement aquatic habitat.		**(SI):** Similar to those described under Proposed Action.	
Water quality – regulated sources		**(SI):** Increased nutrient loading in Gallatin. **(CI):** Cumulative impacts from regulated sources which contribute nutrients. Increases in sediment loading due to projected levels development on undeveloped and partially developed private land. Expansion residential development in Big Sky likely increase service connections to Big Sky County Water and Sewer District. This increase could lead to more nutrient loading in Gallatin River if District uses its MPDES flow-based discharge permit. Cumulative impacts regulated and nonregulated development lead to measurable increases in pollutant levels in Gallatin River.		**(SI):** Due to restriction nutrient loading from subsurface wastewater treatment systems, septic system drainfields outside footprint when development lies within footprint. This placement may concentrate drainfields adjacent to footprint boundary, potentially impacting other groundwater sources due spatial limits on drainfield locations. New development may be forced outside footprint. **(CI):** Cumulative impacts to water quality of Gallatin River would less than from No Action Alternative, since pollution from regulated sources of nutrients capped by "no measurable change" criteria.		**(SI):** Developers may seek approval sooner than later for drainfields within footprint to take advantage of waste load allocation. May encourage faster development within footprint until cumulative impacts analysis indicates trigger value met, then placement may concentrate drainfields adjacent to footprint boundary, potentially impacting other groundwater sources.	
Water quality – nonregulated sources	**(CI):** Sources wastewater discharge, not regulated by the federal, state or local agencies, not addressed. Cumulative degradation from these sources & permissible nonpoint sources may degrade water quality.	**(SI):** Unregulated development may lead measurable nutrient increases receiving streams; including landscape fertilizer runoff, livestock associated with recreation industry, release soil nutrients from timber clearing, increased storm water runoff, or general soil disturbance.					

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Cumulative Impacts		**(CI):** Cumulative impacts from multiple independently proposed developments not evaluated in regulatory framework.		**(SI):** Accounts for cumulative impacts subsurface wastewater treatment by limiting total nutrient loading under low flow conditions to below measurable change, i.e. trigger value for phosphorus.		**(SI):** Similar to Proposed Action.	
Mixing zones		**(SI):** If nondegradation limits nutrients not met in ground water prior to effluent reaching Gallatin River, mixing zone in river can be adopted. Result in localized reaches with elevated nutrient levels which may exceed trigger values until attenuation reduces levels below measurable change. Could allow permitting subsurface wastewater treatment systems which rely on mixing zone in Gallatin River for compliance.					
Water withdrawals	**(CI):** Water withdrawals expected increase with more individual wells drilled. Impact directly related to number SFEs using individual or community wells. (See Impacts described under Land Use and Socioeconomics for these numbers)						
Nutrient input		**(SI):** Increased transport nutrients to receiving waters (Gallatin River or tributaries). Increase nutrients could enhance algal and periphyton growth.		**(SI):** Decreased transport nutrients to receiving waters (Gallatin River or tributaries). Maintenance nutrient levels in ORW reach would limit proliferation periphyton and nuisance algae. **(CI):** Increase service connections to Big Sky County Water and Sewer District could cause more nutrient loading in Gallatin River if District uses its MPDES flow-based discharge permit.	**(SI):** Nutrient input could not increase with mitigation. Impacts same as under Proposed Action	**(SI):** Intermediate between those described under Proposed Action and No Action. Cumulative assessment should reduce overall nutrient input compared to No Action.	**(SI): N**utrient input could not increase with mitigation. Impacts same as under unmitigated Cumulative Impacts Analysis Alternative.

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Wastewater discharge and management		**(SI):** Increased nutrient loading soils result in nutrient saturation, primarily inorganic phosphorus. Increased mass soil containing or holding contaminants within footprint.		**(SI):** Reduced nutrient loading soils from subsurface wastewater treatment in footprint. Less nutrient loading soils due to limit of receiving stream (Gallatin River or tributaries) required have no measurable change water quality.	**(SI):** To meet ORW regulations nutrient input could not increase with mitigation. Therefore Impacts in this area would be the same as under the Proposed Action Alternative	**(SI):** Similar those under Proposed Action.	**(SI):** Nutrient input could not increase with mitigation. Impacts same as under unmitigated Cumulative Impacts Analysis Alternative.
Geology and Soils							
Ground disturbance	Disturbance would occur.	**(SI):** Increased erosion of disturbed soils could degrade water quality. **(CI):** Development footprint continues to full build-out.	**(CI):** Development and ground disturbance could occur same or greater density as unmitigated alternative.	**(CI):** Limits development could potentially limit total ground disturbance.	**(CI):** Development and ground disturbance could occur with same or greater density as unmitigated alternative.	**(CI):** Total acres disturbed for developed units probably between no-action and proposed action alternative.	**(CI):** Development and ground disturbance could occur with same or greater density as unmitigated alternative.
Erosion/sediment transport	**(CI):** Increased sediment loading due to projected levels development on undeveloped and partially developed private land.						
Developable terrain	Development in footprint would continue.	**(SI):** Greater likelihood disturbance wetlands & riparian habitat. **(CI):** Development footprint continues on suitable terrain. Development steep terrain likely.	**(CI):** Development in footprint same or greater density, within limits of zoning regulations, if alternative wastewater management facilities employed.	**(SI):** To prevent receiving streams from experiencing measurable water quality change, sources nutrient loads to groundwater hydrologically connected to streams within footprint limited. Within footprint some development could shift to less amenable terrain; steeper slopes or less stable soils. Could cause soil disturbance steeper areas with higher erosion potential.	**(CI):** Development in footprint with density equal to or greater than under No Action if alternative wastewater management employed.	**(CI):** Total numbers developed units probably between No Action and proposed action. Difficult to assess spatial arrangement on developable terrain.	**(CI):** Development in footprint with density equal to or greater than No Action could occur if alternative wastewater management facilities employed.
Wastewater management		**(PI):** Less stringent management. **(SI):** Increased nutrient loading to soils result in nutrient saturation, primarily inorganic phosphorus. Increased mass soil containing/holding contaminants within footprint. Increased transport nutrients to receiving waters.		**(SI):** Reduced nutrient loading to soils from subsurface wastewater treatment in footprint. Less nutrient loading soils due to limit of receiving waters required to have no measurable change water quality. Decreased transport nutrients to receiving waters.	**(SI):** Nutrient input could not increase with mitigation. Impacts same as under Proposed Action.	**(SI):** Similar to Proposed Action.	**(SI):** To meet cumulative assessment regulations, nutrient input could not increase with mitigation. Impacts same as under unmitigated Cumulative Impacts Analysis Alternative.

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Land Use and Recreation							
Land use - general		**(SI):** No impact on existing or planned land use within footprint or beyond ORW study area. Development would proceed according to plans/regulations agencies having land use jurisdiction within footprint.	**(SI):** Same as No Action without mitigation.	**(SI):** Restrict new development using conventional septic tank/leach fields in footprint. Development restrictions on private land equally applied to all undeveloped or partially developed land in footprint.	**(SI):** Development restrictions could be entirely mitigated by use alternative wastewater management systems. Use of such systems involves increased development cost. Feasibility primarily a function of economics of individual development proposals.	**(SI):** New development in footprint using conventional septic tank/leach field would likely b restricted, but t lesser extent than allowed by Proposed Action without mitigation, due to continued availability narrative standard & authorization to degrade options within existing regulations. Development restrictions (or potential) on private land not equally applied. Permitting of new development on a first come, first served basis. Applicants acting first, before cumulative pollutant trigger values reached able to develop using conventional septic tank/leach fields. Once cumulative trigger values reached, further applicants face increased costs or restrictions on allowable development.	**(SI):** Same as Proposed Action; development restrictions could be mitigated use alternative wastewater management. Development restrictions same as Cumulative Impacts Analysis Alternative without mitigation. First come, first served approach inherent; thus no mitigation possible.
Allowable development		**(SI):** Private Land: Current Gallatin County plans/ zoning regulations allow up to 652 additional dwelling units and estimated 419,000 sq. ft. additional commercial & community facilities built on currently undeveloped or partially developed lands in footprint. Forest Service Land: No plans for new facilities or expansions existing facilities in t footprint. State Land: Montana Fish, Wildlife and Parks may seek expansion Porcupine Creek complex near Big Sky; however no current plans to expand.	**(SI):** Same as No Action without Mitigation	**(SI):** A total of 75 additional dwelling units (DU) and approximately 2,645 sq. ft. additional commercial & community facilities allowed in footprint using conventional septic tank leach field wastewater management systems. This impact represents an 89% reduction in allowable additional dwelling units and an overall 99% reduction in allowable additional commercial or community facilities square footage.	**(SI):** Assuming use of alternative wastewater management, potential additional development in footprint same as described for No Action.	**(SI):** Not possible to quantify allowable development under this alternative due to narrative standard and authorization to degrade variables. Additional development in footprint would likely higher than estimates for Proposed Action without mitigation, due to availability these options. However, given State regulations & policy related to non-degradation, and the same degradation trigger values as under Proposed Action, unlikely that development approaching that expected under No Action would be permitted.	**(SI):** Assuming use of alternative wastewater management, potential additional development in footprint same as described for No Action.

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Recreation	**(PI):** No primary impacts on recreation.	**(SI):** No adverse primary impacts on recreation: Neither levels nor extent of development anticipated in footprint would impose new constraints on river access or capacity of river to accommodate recreation. **(SI):** Secondary water quality impacts due to increased development in footprint can have corresponding secondary impacts on recreation: Adverse fishery impacts (reduced fish size or carrying capacity in ORW reach) would adversely impact angler use and satisfaction; and adverse aesthetic impacts(as algal blooms) could reduce attractiveness of ORW reach. **(C1):** Water quality impacts from development in footprint could act cumulatively with similar impacts from development outside footprint (e.g., the larger Big Sky area), resulting corresponding cumulative secondary impacts to recreation.	**(SI, CI)**: Avoidance of or reduction in secondary or cumulative recreation impacts dependent on mitigation measures applied for secondary water quality impacts. If water quality mitigation successful, corresponding recreation impacts reduced.	**(SI):** Reduction in pollutant loads in river, compared with No Action; long-term positive effect on recreation by protecting river attributes important to recreation users. Quality of recreational experience, as influenced by water quality, protected.	**(SI):** Same as Proposed Action without mitigation.	**(SI):** Same as Proposed Action without mitigation.	**(SI):** Same as Proposed Action without mitigation.
Rafting/boating	**(SI):** Commercial rafting days & private shoreline & river-boating use days expected to continue & may increase slightly. **(CI):** Might be slight increase commercial rafting & recreational tourism.			**(SI):** Probably same as No Action.		**(SI):** Probably same as No Action.	

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Angler use		**(SI):** If trout population declines, recreational fishery could seer reduction in angler use. Potentially fewer anglers make ORW destination for fishing trips. Impacts to popular caddis, mayfly & stonefly hatches could affect recreational fishery. Anglers may fish alternative rivers (Yellowstone & Madison) if seasonal hatches on Gallatin noticeably reduced. Relocation angler activity would reduce associated tourism dollars.		**(SI):** Anglers continue come to Gallatin to fish "blue ribbon" fishery. Angler use may increase in t short term if publicity of ORW designation entices them to the river.		**(SI):** Angler satisfaction likely remains high.	
Angler satisfaction		**(SI):** Adverse impacts to the fishery (i.e. reduced trout growth and carrying capacity, therefore reduced size and numbers of fish) would reduce angler satisfaction.		**(SI):** Angler satisfaction likely remains high or increase with cachet ORW status.		**(SI):** Angler satisfaction likely remains high.	
Socioeconomics							
Angler benefits and economic value		**(SI):** Slight reduction from current $3.84 million value.		**(SI):** Maintain existing $3.84 million dollar value.	**(SI):** Maintain existing $3.84 million dollar value.	**(SI):** Maintain existing $3.84 million dollar value.	**(SI):** Maintain existing $3.84 million dollar value.
Rafting/boating and "other" recreation economic value	**(SI):** Maintenance of existing $6 million net economic value of recreation benefits.	**(SI):** Net economic value to boaters expected to continue or increase slightly. **(SI):** Current trends of increased economic activity associated with recreation expected to continue. However, decrease in water quality associated with No Action could involve potentially adverse effects to existing angler use & spending, but may be offset by positive effects associated with build-out of residential & vacation units. **(CI):** Maintains current local economies of Big Sky & West Yellowstone. Most significant economic loss likely small reduction in net economic value fishing to anglers from reduced trout catch or trout size.		**(SI):** Maintain current quantity & quality recreation uses along ORW. Current annual net economic value fishing & other river-related recreation maintained. ORW designation could be interpreted as signal of quality, & attract additional anglers, further increasing economic value of fishing above current level. Net economic value for non-angling, noncommercial recreation days on river continue. **(CI):** Existing angler and other river recreation use levels, river tourism jobs and income would be maintained.	**(SI):** Maintain current quantity & quality recreation uses along ORW. Current annual net economic value fishing & other river- related recreation maintained. ORW designation could be interpreted as signal of quality, & attract additional anglers, further increasing economic value of fishing above current level. Net economic value for non-angling, noncommercial recreation days on river continue.	**(SI):** Maintain current quantity & quality recreation uses along ORW. Current annual net economic value fishing & other river- related recreation maintained. Net economic value for non-angling, noncommercial recreation days on river continue.	**(SI):** Maintain current quantity & quality recreation uses along ORW to extent that narrative exclusions not granted by DEQ or that advanced wastewater treatment required in footprint. Existing angler & other river recreation use levels maintained

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Tourism related jobs and expenditures		**(SI):** Unknown small losses or small gains to existing 438 jobs & $7.3 million annual out-of-state visitor expenditures.		**(SI):** Maintain existing 438 jobs & $7.3 million annual out-of-state visitor expenditures.	**(SI):** Maintain existing 438 jobs and $7.3 million in annual out-of-state visitor expenditures.	**(SI):** Maintain existing 438 jobs & $7.3 million annual out-of-state visitor expenditures.	**(SI):** Maintain existing 438 jobs & $7.3 million annual out-of-state visitor expenditures.
Recreation employment		**(SI):** Employment with commercial rafting companies continues, & may increase slightly.		**(CI):** Existing net economic values associated with fishing & rafting continue, tourism -related income & employment continue.		**(SI):** Same as Proposed Action.	
Construction related employment		**(SI):** Maintain existing 274 jobs in study area.		**(SI):** If standard subsurface wastewater treatment used in new residential & commercial construction in footprint, reduced build-out would result in eventual loss up to 90 jobs in study area and associated $6.86 million per year worker income loss.	**(SI):** Maintain between 184 & 274 jobs in study area depending on how advanced water treatment is in new homes within footprint. May not result in any job loss if full build-out occurs in footprint by using alternative wastewater treatment.	**(SI):** Eventual loss up to 90 jobs in study area and associated $6.86 million per year worker income loss unless narrative standards approvals are granted or advanced treatment systems used.	**(SI):** Maintain between 184 & 274 jobs in study area depending on how advanced water treatment is in new homes in the footprint & number of narrative standards approvals granted by DEQ. May not result in any job loss if full build-out occurs in footprint by using alternative wastewater treatment.
Other employment sectors		**(SI):** Current level economic activity will maintain current levels direct employment in real estate sector. Associated increase in residents & rental visitors result in small increase income & employment in retail & food services sectors once build-out complete.		**(SI):** Multiplier effects from reduced build-out limitations result in loss up to 30 jobs in real estate, transportation, and local government. **(CI):** Build-out limitations imposed by maintenance existing water quality would eventually reduce direct employment in construction sectors, and multiplier effects would result in slight reductions in real estate & transportation.	**(SI):** Using advanced wastewater treatment, much of e entire build-out associated with No Action could occur. Maintains jobs in real estate, retail and food services. **(CI):** Advanced treatment systems would increase build-out potential in footprint & maintain current levels employment in real estate. Slight increase employment in property management & waste management services with construction & maintenance more effective treatment systems. May not result in job loss if full build-out occurs in footprint by diverting wastewater disposal to outside the footprint.	**(SI):** Multiplier effects from reduced construction up to 30 less jobs real estate, transportation, local government unless narrative standards approvals granted or advanced treatment used.	**(SI):** Maintain jobs real estate, retail & food services depending on advanced water treatment in new homes in footprint and number of narrative standards approvals granted by DEQ. May not result in job loss if full build-out occurs in footprint by diverting wastewater disposal to outside footprint.

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Property value		**(SI):** Reduction in water quality & aesthetics associated with algae will result in slight decline property values or slow down in rise in property values near ORW. **(SI):** 652 more housing units should moderate rise in house/condo price increases, & thus moderate degree of unaffordability of housing compared to household median income in West Yellowstone & Big Sky.		**(SI):** Protect existing property value differential associated with water quality. Limitations on build-out increase new dwelling units, & increase prices for existing & new units. Housing affordability slightly worse than No Action **(CI):** Housing affordability further reduced if demand for housing increases & build-out limited.	**(SI):** Maintain current value or slightly increase rise of values. Housing affordability slightly worse than No Action.	**(SI):** Maintain current value or slightly decrease values due to uncertainty regarding permanence. Housing affordability slightly worse than No Action.	**(SI):** Maintain current value or slightly decrease values in area due to uncertainty regarding permanence. Housing affordability slightly than No Action.
Allowable new homes & commercial space in footprint		**(SI):** 652 dwelling units & 419,000 sq. ft. commercial space.		**(SI):** 67 dwelling units (89% reduction from No Action) and 2,645 sq. ft. commercial space (99% reduction from No action).	**(SI):** Between 67 & 652 new dwelling units & between 2,645 & 419,000 sq. ft. commercial space depending on how advanced water treatment for new homes/commercial businesses in footprint.	**(SI):** 67 dwelling units (89% reduction from No Action) and 2,645 sq. ft. of commercial space (99% reduction from No Action).	**(SI):** Between 67 & 652 new dwelling units & between 2,645 & 419,000 sq. ft. commercial space depending on advanced water treatment for new homes/commercial businesses in footprint or # narrative standards approvals granted by DEQ.
Change in housing costs associated with use of advance wastewater systems		**(SI):** % Change per unit: None $ Change per unit: None Total dollar cost: None	**(SI):** % Change per unit: + 1% to 8% $ Change per unit: $3,200 to $20,000 Total dollar cost: $1.8 to $11.5 million	**(SI):** % Change per unit: None $ Change per unit: None Total dollar cost: None	**(SI):** % Change per unit: + 1% to 8% $ Change per unit: $3,200 to $20,000 Total dollar cost: $1.8 to $11.5 million	**(SI):** % Change per unit: + 1% to 8% $ Change per unit: $3,200 to $20,000 Total dollar cost: $1.8 to $11.5 million	**(SI):** % Change per unit: Less than + 1% to 8% depending on number of narrative standards approvals granted by DEQ. $ Change per unit: $3,200 to $20,000 Total dollar cost: $1.8 to $11.5 million
Passive use/Existence values to Montana households		**(SI):** Slight loss passive use values of MT residents expected with maintaining current water quality.		**(SI):** Passive use values (option, existence & bequest values from water quality) to MT residents associated with current water quality would be maintained.	**(SI):** Passive use values (option, existence & bequest values from water quality) to MT residents associated with current water quality would be maintained.	**(SI):** Passive use values (option, existence and bequest values from water quality) to Montana residents associated with the current water quality would be maintained.	**(SI):** Passive use values (option, existence & bequest values from water quality) to MT residents associated with current water quality would be maintained.

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Aquatic Life and Habitats							
TMDL Program	**(CI):** TMDL programs may reduce nutrient loading. Participation & cooperation with TMDLs voluntary for nonpoint sources (septic systems); no way to quantitatively assess potential nutrient load improvements.						
Water quality – phosphorus and nitrogen loading		**(SI):** Increased phosphorus & nitrogen loading. **(CI):** Potential reduction in flow due to increased well development would diminish overall dilution of nutrients after entering Gallatin River.	**(SI):** Any reductions nutrient levels benefit aquatic community compared to unmitigated No Action Alternative.	**(SI):** Cap on phosphorus & nitrogen loading.	**(CI):** Potential reduction flow due to increased well development would diminish overall dilution nutrients after entering Gallatin River.	**(SI):** Limit on phosphorus & nitrogen loading to trigger values as assessed against existing & permitted nutrient inputs.	**(SI):** Total nutrient loading allowed same as the unmitigated Cumulative Impacts Analysis.
Dissolved oxygen and nitrite levels		**(SI):** Potential reduction in dissolved oxygen due to increased algae. Increased nitrogen levels on trout fry expected to reduce trout numbers or size. **(CI):** Reduction in available oxygen and increased nitrites.	**(SI):** Any reductions nutrient levels would benefit aquatic community compared to unmitigated No Action.	**(SI):** Controlled nutrient levels contribute to maintaining existing dissolved oxygen and nitrite levels.		**(SI):** Similar to Proposed Action.	
Macroinvertebrate community		**(SI):** Shift in composition macroinvertebrate community toward towards more nutrient tolerant community species with less energetic value to trout.. Midges continue to be plentiful, but large hatches of caddis, mayflies, and stoneflies may be reduced.	**(SI):** Any reductions nutrient levels benefit aquatic community compared to unmitigated No Action.	**(SI):** Should remain same as current macroinvertebrate community.		**(SI):** Similar to Proposed Action.	
Periphyton and algae		**(SI):** As nutrient levels increase increased algae. Possible adverse aesthetic impacts (e.g. algal blooms) downstream of ORW reach (within ORW reach, cold water temperatures tend to minimize such impacts from increased nutrient levels).	**(SI):** Any reductions in nutrient levels benefit aquatic community compared to unmitigated No Action.	**(SI):** Algal communities remain same as current with no additional nutrients.		**(SI):** Algal communities remain same as current with no additional nutrients.	

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Fisheries							
Effects to rare, threatened, and endangered species	**(SI):** No aquatic T&E species in study area. Montana species of concern only incidentally encountered in proposed ORW reach, and its not critical habitat for any Montana species of concern. Impacts to these species not significant.						
Effects to fish habitat		**(SI):** Gradual decline water quality would negatively impact fish community & its habitat. **(CI):** Cumulative impacts to Gallatin River's fishery exacerbated by shifts in periphyton & macroinvertebrate communities. Possible decreased surface water supply due to residential water use inside footprint. Any reduction in total surface flow would reduce available habitat for fish, & diminish overall dilution of nutrients entering Gallatin River.	**(CI):** If mitigation reduces overall nutrient input, impacts to fisheries habitat reduced.	**(SI):** Maintenance existing nutrient levels allow persistence high-quality aquatic habitat. **(CI):** Reductions total future numbers septic systems & residential wells help maintain existing groundwater supplies.	**(CI):** If mitigation allows increased build-out near or in riparian zone, potential negative impacts to fisheries habitat.	**(SI):** Minor impacts due to slight increase in nutrient levels.	**(CI):** If mitigation allows increased build-out near or in riparian zone, potential negative impacts to fisheries habitat.
Fish community - eggs/fry	**(CI):** Unregulated nonpoint sediment sources continue to pose potential threat to incubating eggs & fry.	**(SI):** Increased nitrogen levels expected to reduce trout numbers or trout size. If nitrate levels reach 2.0 mg/L, likely to adversely affect rainbow trout fry and eggs.	**(SI):** Any reductions in nutrient levels benefit fish community compared to unmitigated No Action.	**(SI):** Trout reproduction & recruitment likely to continue at current levels.	**(CI):** If mitigation allows increased build-out near riparian zone, possible negative impacts to trout reproduction & recruitment.	**(SI):** Trout reproduction & recruitment likely continue at current levels. Increase nutrient levels not likely significantly different from the Proposed Action.	**(CI):** Impacts likely similar to mitigated Proposed Action.
Fish community - adult		**(SI):** Added stress from increased nitrates; adverse effects on adult growth, reproduction, and survival of fish. If trout carrying capacity decreases, total trout population likely to decrease, or experience reduced growth, increased competition, increased susceptibility to disease, or reduced reproduction success.	**(SI):** Reductions in nutrient levels benefit fish community compared to unmitigated No Action Alternative.	**(SI):** Persistence of existing species diversity & preservation of Gallatin River habitat for salmonids.	**(CI):** If mitigation allows increased build-out near riparian zone, possible negative impacts to trout reproduction & recruitment.	**(SI):** Impacts likely similar to Proposed Action.	**(CI):** If mitigation allows increased build-out near riparian zone, possible negative impacts to trout reproduction & recruitment.

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Macroinvertebrate community shift		**(SI):** Shift composition trout food base may reduce trout numbers or trout size. Changes in aquatic macroinvertebrate community (food base for trout) potentially reduce growth and total carrying capacity of ORW reach. If food quantity or quality decreases, number trout that grow & thrive decreases.	**(SI):** Any reductions in nutrient levels would benefit fish community compared to unmitigated No Action.	**(SI):** Current macroinvertebrate community likely persists & provide consistent food base for trout.		**(SI):** Impacts likely similar to Proposed Action.	
Terrestrial Vegetation and Habitats							
Development		**(SI):** Increased ground disturbance from retained pace & extent development. **(SI):** Ground disturbance for development of permanent structures result in permanent loss of vegetation. Vegetative disturbances may be short-term if rough graded & soft graded areas revegetated with native species. Removal of existing weed biomass & seed source may be beneficial impact. **(CI):** Removal vegetation within riparian zone may cause cumulative impacts on water catchment, infiltration, & delivery from rain. These changes in soil water content & water availability negatively affect vegetation but may benefit some noxious weeds.		**(SI):** Decreased ground disturbance due to reduction extent of development. **(SI):** Reduction in build out result in less permanent loss of vegetation. Vegetative disturbances may be short-term if rough graded & soft graded areas revegetated with native species. **(CI):** Cumulative impacts same as No Action alternative, but to lesser extent.	**(SI):** Increased ground disturbance from retained pace & extent development. **(SI):** Ground disturbance for development permanent structures would result in permanent loss of vegetation. Vegetative disturbances may be short-term if rough graded & soft graded areas revegetated with native species. Removal existing weed biomass and seed source may be beneficial impact. **(CI):** Removal vegetation within riparian zone may cause cumulative impacts on water catchment, infiltration, & delivery from rain. These changes in soil water content & water availability negatively affect vegetation but may benefit some noxious weeds.	**(SI):** Decreased ground disturbance due to reduction in extent of development. **(SI):** Reduction build out result in less permanent loss of vegetation. Vegetative disturbances may be short-term if rough graded &soft graded areas revegetated with native species. **(CI):** Cumulative impacts same as No Action, but to lesser extent.	**(SI):** Increased ground disturbance from retained pace & extent development. **(SI):** Ground disturbance for development of permanent structures result in permanent loss of vegetation. Vegetative disturbances may be short-term if rough graded & soft graded areas revegetated with native species. Removal existing weed biomass & seed source may be beneficial impact. **(CI):** Removal vegetation within riparian zone may cause cumulative impacts on water catchment, infiltration, & delivery from rain. These changes in soil water content & water availability negatively affect vegetation but may benefit some noxious weeds.

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Native plant communities		**(SI):** Native plant communities may be permanently altered or replaced with nonnative species, creating fragmented native habitat. Revegetated areas require time for vegetation to reestablish. **(CI):** Fragmentation could impact overall plant productivity and wildlife use. Fragmentation can impact size and proximity of habitat patches, increase amount of habitat edge, ultimately impacting quality of habitat for birds and mammals.		**(SI):** Native plant communities may be permanently altered or replaced with non-native species, creating fragmented native habitat. Revegetated areas require time for vegetation to reestablish. Impacts reduced if less development occurs. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Native plant communities may be permanently altered or replaced with nonnative species, creating fragmented native habitat. Revegetated areas require time for vegetation to reestablish. **(CI):** Fragmentation could impact overall plant productivity and wildlife use. Fragmentation can impact size and proximity of habitat patches, increase amount of habitat edge, ultimately impacting quality of habitat for birds and mammals.	**(SI):** Native plant communities may be permanently altered or replaced with non-native species, creating fragmented native habitat. Revegetated areas require time for vegetation to reestablish. Impacts reduced if less development occurs. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Native plant communities may be permanently altered or replaced with nonnative species, creating fragmented native habitat. Revegetated areas require time for vegetation to reestablish. **(CI):** Fragmentation could impact overall plant productivity and wildlife use. Fragmentation can impact size and proximity of habitat patches, increase amount of habitat edge, ultimately impacting quality of habitat for birds and mammals.
Effects to rare, threatened, and endangered species		**(PI):** Potential removal of slender Indian paintbrush plants. **(SI):** Impacts from noxious weeds on species of concern include potential increased competition, displacement, & plant damage or mortality resulting from herbicide drift during weed management. **(CI): I**mpacts on species of concern vary. Potential impacts caused by development & other ground disturbances could affect species ability to persist, & vulnerabilities to extinction in Montana.		**(SI):** Could limit number of future dwelling units and commercial properties. Impacts to plants of concern are less likely. **(CI):** Same as No Action, but to lesser extent.	**(PI):** Potential removal of slender Indian paintbrush plants. **(SI):** Impacts from noxious weeds on species of concern include potential increased competition, displacement, & plant damage or mortality resulting from herbicide drift during weed management. **(CI): I**mpacts on species of concern vary. Potential impacts caused by development & other ground disturbances could affect species ability to persist, & vulnerabilities to extinction in Montana.	**(SI):** Could limit number of future dwelling units and commercial properties. Impacts to plants of concern are less likely. **(CI):** Same as No Action, but to lesser extent.	**(PI):** Potential removal of slender Indian paintbrush plants. **(SI):** Impacts from noxious weeds on species of concern include potential increased competition, displacement, & plant damage or mortality resulting from herbicide drift during weed management. **(CI): I**mpacts on species of concern vary. Potential impacts caused by development & other ground disturbances could affect species ability to persist, & vulnerabilities to extinction in Montana.

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Slender Indian paintbrush		**(PI):** Potential removal slender Indian paintbrush plants. **(SI):** This species vulnerable to hydrologic alterations if water table lowered by increased number of wells. Will incur greatest impacts from future development since occurs on private lands that are partially developed. Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Any loss in abundance or habitat for slender Indian paintbrush probably not affect ability to persist in Gallatin County.		**(SI):** Vulnerability to hydrologic alterations reduced due to fewer SFEs & thus fewer wells. Direct impacts to slender Indian paintbrush less likely. Because occurrences next to existing roads & trails, degree of secondary impacts same as under No Action. Habitat could experience impacts from noxious weed spread. **(CI):** Impacts on slender Indian paintbrush would not affect ability to persist in Gallatin County.	**(PI):** Potential removal slender Indian paintbrush plants. **(SI):** This species vulnerable to hydrologic alterations if water table lowered by increased number of wells. Will incur greatest impacts from future development since occurs on private lands that are partially developed. Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Any loss in abundance or habitat for slender Indian paintbrush probably not affect ability to persist in Gallatin County.	**(SI):** Vulnerability to hydrologic alterations reduced due to fewer SFEs & thus fewer wells. Direct impacts to slender Indian paintbrush less likely. Because occurrences next to existing roads & trails, degree of secondary impacts same as under No Action. Habitat could experience impacts from noxious weed spread. **(CI):** Impacts on slender Indian paintbrush would not affect ability to persist in Gallatin County.	**((PI):** Potential removal slender Indian paintbrush plants. **(SI):** This species vulnerable to hydrologic alterations if water table lowered by increased number of wells. Will incur greatest impacts from future development since occurs on private lands that are partially developed. Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Any loss in abundance or habitat for slender Indian paintbrush probably not affect ability to persist in Gallatin County.
Hall's rush		**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Ability persist in Gallatin County may be reduced. Overall viability in Montana &global range not impacted.		**(SI):** Habitat could experience impacts from noxious weed spread. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Ability persist in Gallatin County may be reduced. Overall viability in Montana &global range not impacted.	**(SI):** Habitat could experience impacts from noxious weed spread. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Ability persist in Gallatin County may be reduced. Overall viability in Montana &global range not impacted.
Large-leafed balsamroot		**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Ability persist in Gallatin County may be reduced. Overall viability in Montana &global range not impacted.		**(SI):** Habitat could experience impacts from noxious weed spread. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Ability persist in Gallatin County may be reduced. Overall viability in Montana &global range not impacted.	**(SI):** Habitat could experience impacts from noxious weed spread. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Ability persist in Gallatin County may be reduced. Overall viability in Montana &global range not impacted.

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Discoid goldenweed		**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Potential impacts caused by development & other ground disturbances could increase vulnerability to extinction in Montana, but not global viability.		**(SI):** Habitat could experience impacts from noxious weed spread. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Potential impacts caused by development & other ground disturbances could increase vulnerability to extinction in Montana, but not global viability.	**(SI):** Habitat could experience impacts from noxious weed spread. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Potential impacts caused by development & other ground disturbances could increase vulnerability to extinction in Montana, but not global viability.
Noxious weeds		**(SI):** Future development has potential to increase area & density of infestations. Soil brought in for development may provide better habitat for weeds than native soil. If development spreads weed seed to new areas, weeds become a problem on additional public & private lands. Conversely, removal existing weed biomass & seed source may be beneficial. **(CI):** Cumulative impacts of noxious weed spread may include declines in native plant community diversity, increased sedimentation, & decreased wildlife or livestock forage.		**(SI):** Reduced development result in less ground disturbance (assuming no mitigation), thus secondary impacts of noxious weed spread lower. **(CI):** Cumulative impacts noxious weed spread may include declines native plant community diversity, increased sedimentation, & decreased wildlife or livestock forage.	**(SI):** Future development has potential to increase area & density of infestations. Soil brought in for development may provide better habitat for weeds than native soil. If development spreads weed seed to new areas, weeds become a problem on additional public & private lands. Conversely, removal existing weed biomass & seed source may be beneficial. **(CI):** Cumulative impacts of noxious weed spread may include declines in native plant community diversity, increased sedimentation, & decreased wildlife or livestock forage.	**(SI):** Reduced development result in less ground disturbance (assuming no mitigation), thus secondary impacts of noxious weed spread lower. **(CI):** Cumulative impacts noxious weed spread may include declines native plant community diversity, increased sedimentation, & decreased wildlife or livestock forage.	**(SI):** Future development has potential to increase area & density of infestations. Soil brought in for development may provide better habitat for weeds than native soil. If development spreads weed seed to new areas, weeds become a problem on additional public & private lands. Conversely, removal existing weed biomass & seed source may be beneficial. **(CI):** Cumulative impacts of noxious weed spread may include declines in native plant community diversity, increased sedimentation, & decreased wildlife or livestock forage.

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Wildlife							
Wildlife - general	**(PI):** No primary impacts to wildlife.	**(SI):** If eutrophication reduces fish or invertebrate productivity or changes species composition, fish-eating (river otter, bald eagle, osprey or mergansers) or insect-eating (shrews, swallows or warblers) wildlife may be affected by change in prey base. **(CI):** Habitat losses from increased development combined with other habitat losses & increased encroachment on wildlife habitat may cumulatively affect wildlife by reducing long-term population viability. Species less compatible with humans (grizzly bear) or those requiring larger areas contiguous habitat; more likely affected.	**(SI):** Using alternative water treatment so no negative effects on aquatic ecology; would be no impacts to wildlife from reduced water quality. **(CI):** Zoning, planning development with wildlife habitat as focus, and implementing & enforcing food & garbage storage policies could reduce impacts to wildlife from increased development.	**(SI):** Secondary impacts to wildlife may be beneficial. Proposed Action represents the potential for an overall 89% reduction in allowable dwelling units & 99% reduction in commercial square footage (less habitat loss), as well as long term protection of water quality. **(CI):** Any impacts beneficial relative to No Action.	**(SI):** Mitigation would make build-out potential nearly identical to No Action. Increase in build-out nullifies the benefits to wildlife due to reduced land use in footprint.	**(SI):** Impacts to wildlife likely intermediate between Proposed Action & No Action. Magnitude of impact depends on use of narrative standard, approval of application to degrade. If surge in development occurs early on, & DEQ's continued adherence to Cumulative Impacts Analysis. **(CI):** Likely similar to Proposed Action & beneficial compared to No Action.	**(SI):** Impacts with mitigation would be intermediate to impacts with mitigation from the No Action & Proposed Action alternatives.
Habitat		**(SI):** Increased development could cause habitat loss, habitat fragmentation, & increased disturbance by humans. Fragmentation plant communities detrimental to plant productivity & therefore wildlife use. Higher density development translates to more disturbances to wildlife, through traffic, domestic pets, & general human activity.		**(SI):** Less loss of habitat with less development, beneficial for wildlife.		**(SI):** Impacts to wildlife likely intermediate between Proposed Action & No Action. Magnitude of impact depends on use of narrative standard, approval of application to degrade. If less loss of habitat with less development, beneficial for wildlife.	
Effects to rare, threatened, and endangered species		**(SI):** Bald eagles could be negatively affected if No Action Alternative results in degraded water quality & reduction in prey base. Grizzly bears could be affected by increased human development & use in bear habitat. Effects to wolves or lynx not likely significant or measurable.		**(SI):** Would not adversely affect federally listed wildlife species, & may have beneficial effects. If Proposed Action results in lower dwelling unit density, loss of habitat & human disturbance less than under the No Action. Preservation water quality beneficial to bald eagles & indirectly to other species.		**(SI):** Would not adversely affect federally listed wildlife species, & may have beneficial effects. If Cumulative Impacts Analysis results in lower dwelling unit density, loss of habitat & human disturbance less than under the No Action. Preservation water quality beneficial to bald eagles & indirectly to other species.	

Table E-1. Condensed description of potential impacts related to the three alternatives considered in detail in the Gallatin River Outstanding Resource Water Designation Draft Environmental Impact Statement.

Potential Impact **(PI) = Primary** **(SI) = Secondary** **(CI) = Cumulative**	**Common to All Action Alternatives**	**Alternative 1: No Action**	**Alternative 1: No Action with Mitigation Measures**	**Alternative 2: Proposed Action**	**Alternative 2: Proposed Action with Mitigation Measures**	**Alternative 3: Cumulative Impacts Analysis**	**Alternative 3: Cumulative Impacts Analysis with Mitigation Measures**
Air Quality							
	(SI): Some gradual decrease in air quality as level of development in Gallatin Canyon increases.			**(SI):** May limit development, & therefore less air pollution from fewer future construction activities.	**(SI):** If mitigations implemented virtually no difference in development potential & subsequent impacts to air quality compared to No Action.		
Cultural Resources							
	(PI): No primary impacts to cultural resources likely. **(CI):** Possibly cumulative impacts to cultural resources.	**(SI):** Impacts cultural resources within study area due to ground disturbance during site development. Entire study area has not been surveyed; therefore, total number & distribution sites currently not known. However, given existing documentation, reasonable to assume some disturbance of cultural sites.		**(SI):** With less development, less ground disturbance and lowered impacts to cultural resources.	**(SI):** If mitigations adopted, Proposed Action will present secondary impacts virtually identical to those under No Action.	**(SI):** If less development, less ground disturbance and lowered impacts to cultural resources.	
Aesthetics							
Visual resources	**(PI):** None. **(CI):** No effects to visual character or appearance of surrounding viewsheds or topography.	**(SI):** Aesthetic impacts from increased development primarily noticeable in commercial & residentially zoned areas. Density of development may impact aesthetic quality of the corridor near highway. **(CI):** Development could continue to full build-out; could impair aesthetic quality of river corridor near highway.		**(SI):** Substantially reduced level from No Action. Reduction in density of development would protect aesthetic quality of river corridor. **(CI):** Future development could impair aesthetic quality of river corridor near highway, but reduced from No Action.	**(SI):** Impacts same as No Action. **(CI):** Development to full build-out, which could impair aesthetic quality of river corridor near highway.	**(SI):** Substantially reduced level from No Action. Reduction in density of development would protect aesthetic quality of river corridor. **(CI):** Future development could impair aesthetic quality of river corridor near highway, but reduced than No Action.	**(SI):** Impacts same as No Action. **(CI):** Development to full build-out, which could impair aesthetic quality of river corridor near highway.

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Glossary: Acronyms, Abbreviations, and Useful Terminology

ARM	Administrative Rules of Montana
BWTF	Blue Water Task Force
CCD	Census County Division
CDP	Census County Place
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second (flow of water)
DEQ	Montana Department of Environmental Quality
DU	Dwelling Unit
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FS	Forest Service
GCPD	Gallatin County Planning Department
GCEHS	Gallatin County Environmental Health Services
GNF	Gallatin National Forest
GPD	Gallons per Day
HUC	Hydrologic Unit Code
MCA	Montana Code Annotated
MEPA	Montana Environmental Policy Act
MPDES	Montana Pollutant Discharge Elimination System
MSPA	Montana Subdivision and Platting Act
MSSA	Montana Sanitation in Subdivisions Act
NAIP	National Agriculture Imagery Program
NGVD 29	National Geodetic Vertical Data 1929
NRIS	National Resource Information System
ONRW	Outstanding National Resource Water
ORW	Outstanding Resource Water
P	Inorganic phosphorus
PIC	Per Single Family Equivalent
SF	Square Feet
SFE	Single Family Equivalent
TMDL	Total Maximum Daily Load
WMA	Wildlife Management Area
WTP	Willingness to Pay
WWTS	Wastewater treatment system
7Q10	The 7-day, 10-year low flow level of the impacted section of a stream

Alluvial aquifer
Water bearing zone in the alluvium.

Alluvium Material, such as sand, silt, or clay, deposited on land by streams.

Ammonium A form of nitrogen with the chemical formula NH_{4+}, or a compound containing nitrogen in that form. Can be toxic to fish.

Angler day An angler day is a period fished by one person, up to an entire day. If four people fish together and each of them fishes for 2 hours, this constitutes four angler days.

Analyte The substance which a laboratory tests to detect.

Aquifer An underground layer of that yields water for wells.

Aquifer vulnerability
The tendency or likelihood for contaminants to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer.

Basement rock
The oldest rocks in a given area; a complex of metamorphic and igneous rocks that underlies the sedimentary deposits. Usually Precambrian or Paleozoic in age.

Bedrock The solid rock that underlies the soil and other unconsolidated material or that is exposed at the Earth's surface.

Benthic macroinvertebrates
Visible invertebrate organisms, such as insect larvae, worms, and clams, which live on the bottom of bodies of freshwater.

Bequest value
The value that people place on something, knowing that future generations will have the option to enjoy it. See also nonuse value.

Biological attenuation
The breakdown of organic contaminants by microbial organisms into smaller compounds. The microbial organisms transform the contaminants through metabolic or enzymatic processes. Biological attenuation processes vary greatly, but frequently the final product is carbon dioxide or methane.

Confluence The location where two rivers flow together or a stream flows into a larger river.

Degradation A change in water quality that lowers the quality of high quality waters for a parameter (75-5-103, MCA). It also means any increase of a discharge that

exceeds the limits established under or determined from a permit or approval issued by the department prior to April 29, 1993.

Detection limit
The lowest level which an analyte can be detected in a sample.

Detritivores Organisms that eat detritus - decaying loose matter on the bottom of bodies of water such as streams and rivers.

Drainfield The area underground that a septic system drains into.

Dwelling unit (DU) A residence or home. A single unit providing complete independent living facilities for one (1) or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation, limited to only one (1) kitchen. A dwelling unit can vary substantially in size and is most relevant to zoning.

Effluent Something that flows out; as a stream flows out of a lake or the fluid coming out of a sewer or septic system.

Elasticity A measure of responsiveness in economics. The responsiveness of behavior, measured by variable Z, to a change in environment variable Y is the change in Z observed in response to a change in Y. Specifically, this approximation is common: elasticity = (percentage change in Z) / (percentage change in Y).

Eutrophication
Natural and human-influenced process of enrichment of a waterbody's nutrient concentrations, especially by nitrogen and phosphorous, leading to an increase in production of organic matter.

Existence value
The value that people place on simply knowing that something exists, even if they will never see it or use it. Synonymous with passive use value and nonuse value.

Existing water quality
The quality of the receiving water, including chemical, physical, and biological conditions immediately prior to commencement of the proposed activity or that which can be adequately documented to have existed on or after July 1, 1971, whichever is the highest quality.

Fen A wet area rich in peat and other organic matter characterized by neutral to alkaline soil conditions, and often by some surface-water flow in and out of its environment.

Footprint Land along the ORW reach and its tributaries where groundwater can come into contact with surface water (hydrologic connection). This area is defined by geology, soil type, distance from the river's banks, and height above the river's surface.

Forb Broad-leaved, non-woody plants growing in fields and meadows; does not includes grasses

Gneiss A coarse-grained metamorphic rock formed in or composed of separable layers. Marked by bands of light-colored minerals, such as quartz and feldspar, that alternate with bands of dark-colored minerals. This alternation develops through metamorphic differentiation.

Gradient The vertical drop in a stream's elevation over a given horizontal distance, expressed as an angle. Change in groundwater elevation per unit length.

Graminoid Grasses and similar plants such as sedges and rushes.

Ground water
Water occupying the voids within a geologic stratum (layer) and within the zone of saturation.

Hedonic Of or relating to utility. (Literally, pleasure-related.) A hedonic econometric model is one where the independent variables are related to quality; e.g. the quality of a product that one might buy or the quality of a job one might take.

High quality waters (surface)
All state waters, except: … (b) surface waters that: (i) are not capable of supporting any one of the designated uses for their classification (ARM 17.30 sub-chapter 6); or (ii) have zero flow or surface expression for more than 270 days during most years (75-5-103(10), MCA).

High potential sediment delivery
Materials which are highly erosive and therefore can send large amounts of sediment to receiving waters during water events.

Hydraulic conductivity
The extent to which a given substance allows water to flow through it, determined by such factors as sorting and grain size and shape in soil. A function of porous medium and fluid used to determine groundwater velocity.

Hydrogeology
The study of groundwater.

Igneous rock A rock made from molten (melted) or partly molten material that has cooled and solidified.

Karst An area in limestone formations where groundwater has created cracks, sinkholes, underground streams, and caverns.

Lithology Physical character of rock.

Mean high water line
The line which the water impresses on the soil by covering it for sufficient periods to deprive it of vegetation.

Metamorphic rock
A rock that has undergone chemical or structural changes. Heat, pressure, or a chemical reaction may cause such changes.

Migmatite A rock that incorporates both metamorphic and igneous materials

Mitigation An action taken to moderate or alleviate an impact.

Montana Pollutant Discharge Elimination System
This permit system was developed by the state of Montana for controlling the discharge of pollutants from point sources into state waters, pursuant to ARM Title 17, chapter 30, subchapter 13.

New or increased source
An activity resulting in a change of existing water quality occurring on or after April 29, 1993. The term does not include the following: (a) sources from which discharges to state waters have commenced or increased on or after April 29, 1993, provided the discharge is in compliance with the conditions of, and does not exceed the limits established under or determined from, a permit or approval issued by the department prior to April 29, 1993; (b) nonpoint sources discharging prior to April 29, 1993; (c) withdrawals of water pursuant to a valid water right existing prior to April 29, 1993; and (d) activities or categories of activities causing nonsignificant changes in existing water quality pursuant to ARM 17.30.715, 17.30.716, or 75-5-301(5)(c), MCA. (as defined in ARM 17.30.702(18)).

Nitrate A form of nitrogen with the chemical formula NO_{3-}, or a compound containing nitrogen in that form. Readily taken up by algae. Not toxic.

Nitrite A form of nitrogen with the chemical formula NO_{2-}, or a compound containing nitrogen in that form. Readily taken up by most algae; however can be toxic to fish.

Nondegradation
Related to not degrading the quality of something, such as water in a river.

Nondegradation standards
Standards for measuring impacts from nutrients to receiving waters based on 50-year break-through values, trigger values, or narrative standards.

Nonpoint source
A diffuse source of pollutants resulting from the activities of people over a relatively large area, the effects of which normally must be addressed or controlled by a management or conservation practice.

Nonuse value The nonuse value is the value that individuals may attach to the mere knowledge of the existence of something, as opposed to having direct use of that thing. Synonymous with existence value and passive use value.

Option value The value that people place on having the option to enjoy something in the future, although they may not currently use it.

Ordinance A statute or regulation.

Outstanding resource water (ORW)
State surface waters that are located in national parks or national wilderness areas. ORW also refers to state waters that have been identified as possessing outstanding ecological or domestic water supply significance and subsequently have been classified as an ORW by the Board of Environmental Review and approved by the Legislature.

Passive use value
Synonymous with existence value and nonuse value. The passive use value is the value that individuals may attach to the mere knowledge of the existence of something, as opposed to having direct use of that thing.

Periphyton Algae attached to the bottom substrate in almost all aquatic systems.

Physiographic province
A region of the landscape with distinctive geographical features. A contiguous area characterized by similar elevations, relief, geologic structure and geologic history.

Plat A plan, map, or chart of a city, town, section, or subdivision indicating the location and boundaries of individual properties; or a map or sketch of an individual property that shows property lines and may include features such as soils, building locations, vegetation, and topography.

Point source A discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, or vessel or other floating craft, from which pollutants are or may be discharged (Montana Water Quality Act (75-5-103), MCA).

Pollutant A measurable entity that pollutes, such as something introduced into a body of water (for example nitrogen).

Pollution Things that pollute, degrade, and contaminate; for water quality includes such things as dewatering or increased temperature.

Primary treatment
The first step in wastewater treatment. Primary treatment includes settling of solids and aeration to facilitate biological decomposition. See also secondary and tertiary treatment.

Recharge The entry of water into the saturated zone of water in the soil made available at the water-table surface.

Riparian The areas along the margins of a stream, river or lake; the banks of a river.

Secondary treatment
The second step in wastewater treatment) is a biological treatment of wastewater to remove dissolved organic matter. Sewage microorganisms are cultivated and added to the wastewater. The microorganisms absorb organic matter from sewage as their food supply. Three approaches are used to accomplish secondary treatment; fixed film, suspended film and lagoon systems. Lagoon systems are shallow basins which hold the wastewater for several months to allow for the natural degradation of sewage. See also primary treatment and tertiary treatment).

Sediment delivery
Contribution of transported sediment to a particular location or part of a landscape.

Setback The minimum distance from a watercourse allowed for construction of a building or site improvement.

Single Family Equivalent
(SFE) An SFE is defined by the amount of wastewater expected to be generated by a residence or business based on data compiled by agencies (e.g. Water and Sewer Districts, DEQ, etc). DEQ defines an SFE as a two-bedroom, two-bath residence.

Snow water equivalent
Snow thickness on the ground translated to equivalent amount as water.

Tertiary treatment
Final treatment of wastewater focuses on removal of disease-causing organisms. Treated wastewater can be disinfected by adding chlorine or by using ultraviolet light. High levels of chlorine may be harmful to aquatic life in receiving streams. Treatment systems often add a chlorine-neutralizing chemical to the tertiary treated wastewater before stream discharge. (See also primary treatment and secondary treatment).

Trigger values

Values used to determine if a given increase in the concentration of a toxic parameter is “significant” or “non-significant” under nondegradation rules (DEQ 2004, ARM 17.30.706). Trigger values are developed for all numeric water quality standards.

Unconsolidated deposits

Uncemented nonbedrock material.

Undercut bank

Bank with a cavity below the water line that is maintained by erosion or scour from high velocity flow.

Viewshed A viewshed is an area of land, water, and other environmental elements that is visible from a fixed vantage point. In urban planning, for example, viewsheds tend to be areas of particular scenic or historic value that are deemed worthy of preservation against development or other change.

Watershed The land area that drains water to a particular stream, river, or lake. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. Large watersheds, such as the Missouri River basin. contain hundreds of smaller watersheds.

Willingness to pay

The amount—measured in goods, services, or dollars—that a person is willing to give up to get a particular good or service.

Xeric Dry areas, or plants that are adapted to dry habitats.

Zooplankton Small or microscopic, floating animals in water. Serve as a food source to larger animals such as fish.

50-Year break-through

The travel time limit for a pollutant from its source to receiving waters.

Chapter 1: Purpose and Benefits of Proposed Action

1.1 Introduction

The “Purpose and Benefits” section of an Environmental Impact Statement (EIS) provides the context for the decision to be made. The purpose of the proposed Outstanding Resource Water (ORW) designation is to protect the existing water quality in the Gallatin River from the Yellowstone National Park boundary downstream to the confluence with Spanish Creek (the proposed ORW reach). In Chapter 1, the reason for this level of protection is explained, and the legal and procedural framework of Montana’s ORW designation process is examined. The Montana Department of Environmental Quality (DEQ) must decide whether or not to recommend the ORW designation.

1.2 ORW Designation

1.2.1 Background

In 1995, the Montana Legislature adopted procedures and requirements for the ORW designation process based upon regulations promulgated by the U.S. Environmental Protection Agency (EPA) under the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). Under federal regulations, each state is required to adopt an ORW designation and a process for designating suitable waterbodies. The process and protection framework used by states are generally modeled after the Outstanding National Resource Water (ONRW) designation, defined in federal regulations at 40 CFR 131.12. The ONRW provisions in 40 CFR 131.12 provide the maximum protection of water quality for waters with ecological and recreational significance.

1.2.2 Montana’s ORW Designation Process

Montana’s ORW statutes automatically extend ORW protection to state waters located in national parks or national wilderness areas (75-5-103(20), Montana Code Annotated (MCA)). ORWs can also include state waters that have been identified via the petition process as possessing outstanding ecological, environmental, or economic significance, and subsequently have been classified as ORWs by the Montana Board of Environmental Review (Board) (75-5-315, MCA).

To begin the ORW designation process for a waterbody in Montana, a person or organization must submit a petition to the Board. The petition must present information supporting ORW designation. The Board may only classify a waterbody as an ORW if it accepts a petition and finds that: 1) the waterbody identified in the petition constitutes an ORW based on specific criteria; 2) the classification is necessary to protect the ORW; and 3) there is no other effective process available that would achieve the necessary protection. The Board considers the following criteria in determining whether petitioned state waters are ORWs (75-5-316(4), MCA):

(a) whether the waters have been designated as wild and scenic;
(b) the presence of endangered or threatened species in the water;
(c) the presence of an outstanding recreational fishery in the water;

(d) whether the waters provide the only source of suitable water for a municipality or industry;
(e) whether the waters provide the only source of suitable water for domestic water supply; and
(f) other factors that indicate outstanding environmental or economic values not specifically mentioned in this subsection.

The Board may determine that compliance with one or more of these criteria is insufficient to warrant classification of the water as an ORW. Although the Board may accept the petition, the Legislature ultimately decides whether or not to designate the waterbody as an ORW. There are no provisions in Montana law for the Board to make an independent designation of an ORW without a petition.

The Board must require the preparation of an EIS after acceptance of a petition (75-5-316(6), MCA). Participation by the general public is important during scoping, the comment period on the Draft EIS, and the Board review periods. Public hearings and comment periods incorporated into the EIS process enable the citizens of Montana to participate in the Board's process for ORW designation, and provide an opportunity for the Board to understand the questions and concerns of the public.

Once a waterbody is designated as an ORW, DEQ may not grant an authorization to degrade under 75-5-303, MCA, or allow a new or increased point source discharge that would result in a permanent change in the ORW's water quality (75-5-303 and 75-5-316, MCA).

1.2.3 The Gallatin River ORW Process

In December 2001, American Wildlands submitted a petition to the Board to initiate rulemaking for the Gallatin River to be designated as an ORW from the border of Yellowstone National Park to the confluence with Spanish Creek. The petitioner believes that the ORW designation is necessary to protect the outstanding character and quality of this section of Gallatin River. The Board reviewed the petition and voted to accept it during its March 2002 meeting. The approval triggered the beginning of the review process, including this EIS. Once the EIS is completed, DEQ will make a recommendation to the Board. The Board will review the EIS and consult with state and local agencies prior to determining whether to grant the petition (75-5-316(8), MCA). If the petition is denied, the Board must identify its reasons for the denial. If the petition is granted, the Board will initiate rulemaking to classify the specified reach of the Gallatin River as an ORW. The rule may then be adopted, but is not effective until approved by the Legislature (75-5-316(9), MCA).

In summary, the purpose of the Proposed Action is to protect water quality within the proposed ORW reach of the Gallatin River. The need for ORW designation detailed in the original petition is based on the high water quality that currently exists on the proposed ORW reach and potential sources of degradation identified in the petition. The petitioner is concerned that several major tributaries of the Gallatin River are now listed as impaired, and that the Montana Water Quality Act contains provisions that allow persons to apply for discharge permits that might result in degradation of the existing water quality (American Wildlands 2001). County zoning and DEQ nondegradation reviews can also allow incremental reductions in water quality. In the absence of

ORW designation, these provisions could potentially allow the water quality in the proposed ORW reach to be degraded over time. In its petition, the sponsor stated that ORW designation was the only mechanism available to remove the potential for this degradation. Specific information on how DEQ conducts nondegradation reviews, and how these reviews and other regulatory procedures will be affected if the Proposed Action is implemented, is contained in Chapter 4.

1.3 Current Status of the Gallatin River and Applicable Water Quality Laws

Montana uses a watershed-based system to classify all waters of the state and determine their designated uses and supporting standards. All classifications have multiple uses, and under only one classification (A-Closed) is a specific use (drinking water) given preference over the other designated uses. Other designated uses include culinary and food processing purposes (after conventional treatment); bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply. At the time of classification, a waterbody need not actually be used for a specific designated use, e.g., as a public drinking water supply; however, the quality of that waterbody must be maintained suitable for that designated use. When existing conditions limit or preclude a designated use, such as when a waterbody is listed as impaired by the state, permitted point source discharges or non-point source discharges are not allowed to make the existing conditions worse.

The Missouri River drainage, to and including the Sun River drainage, is classified as B-1 under Montana's Surface Water Quality Standards and Water-Use Designations (Administrative Rules of Montana (ARM) 17.30.610). This drainage includes the Gallatin River and all its tributaries. Exceptions to the B-1 classification exist within this portion of the Missouri River drainage, but none of them are within, or tributary to, the proposed ORW reach of the Gallatin River.

Waters classified B-1 are to be maintained suitable for all designated uses. Water quality standards for each classification include: the designated uses for a waterbody; the legally enforceable standards that ensure that the uses are supported; and a nondegradation policy that provides additional protection for the waterbody.

1.3.1 Nondegradation

The nondegradation policy is a component of Montana's water quality standards, which establishes rules to be followed when addressing proposed activities that can lower the quality of high quality waters. "High quality waters" include all Montana surface waters except those that have zero surface flow for more than 270 days per year, or that are not capable of supporting any of their designated uses under their current classification (75-5-103(10), MCA). Almost all of Montana's surface waters qualify as "high quality waters."

1.3.2 TMDL Status of Tributaries

When a Montana waterbody fails to meet a water quality standard or is found to be unable to support one or more of its designated uses, it is listed as impaired and placed on the state impaired waterbodies list, also known as the "303(d) list" since this process is outlined in Section

303(d) of the federal Clean Water Act. Under Montana law, DEQ cannot issue a permit for a point source that would further degrade any impaired aspect of water quality of a waterbody on the 303(d) list (75-5-703, MCA). In Montana, DEQ reviews data for waterbodies on the 303(d) list biennially. When referring to a waterbody's impairment status, there is often a year cited to specify which review added or changed an impairment listing. The 2004 303(d) list is the one most recently completed. Waterbodies are listed in terms of the level of support provided for each designated use. Levels of support include "full," "partial," and "non-support," and "insufficient data to determine."

Six waterbodies within the upper Gallatin watershed are on the Montana 303(d) list. Progressing from Spanish Creek upstream, these waterbodies are: Storm Castle Creek, Middle Fork of the West Fork of the Gallatin River, West Fork of the Gallatin River, South Fork of the West Fork of the Gallatin River, Cache Creek, and Taylor Fork. Figure 1-1 maps locations of the tributaries discussed in this section and provides an overview of the upper Gallatin River watershed.

It should be noted that some of the impairment causes listed for the Upper Gallatin River watershed are considered "pollution" by EPA. Dewatering or flow alteration and any type of habitat degradation are considered pollution and not pollutants. The Clean Water Act does not require TMDL development for pollution and, therefore, no loads or water quality targets will be developed for these causes for impairment.

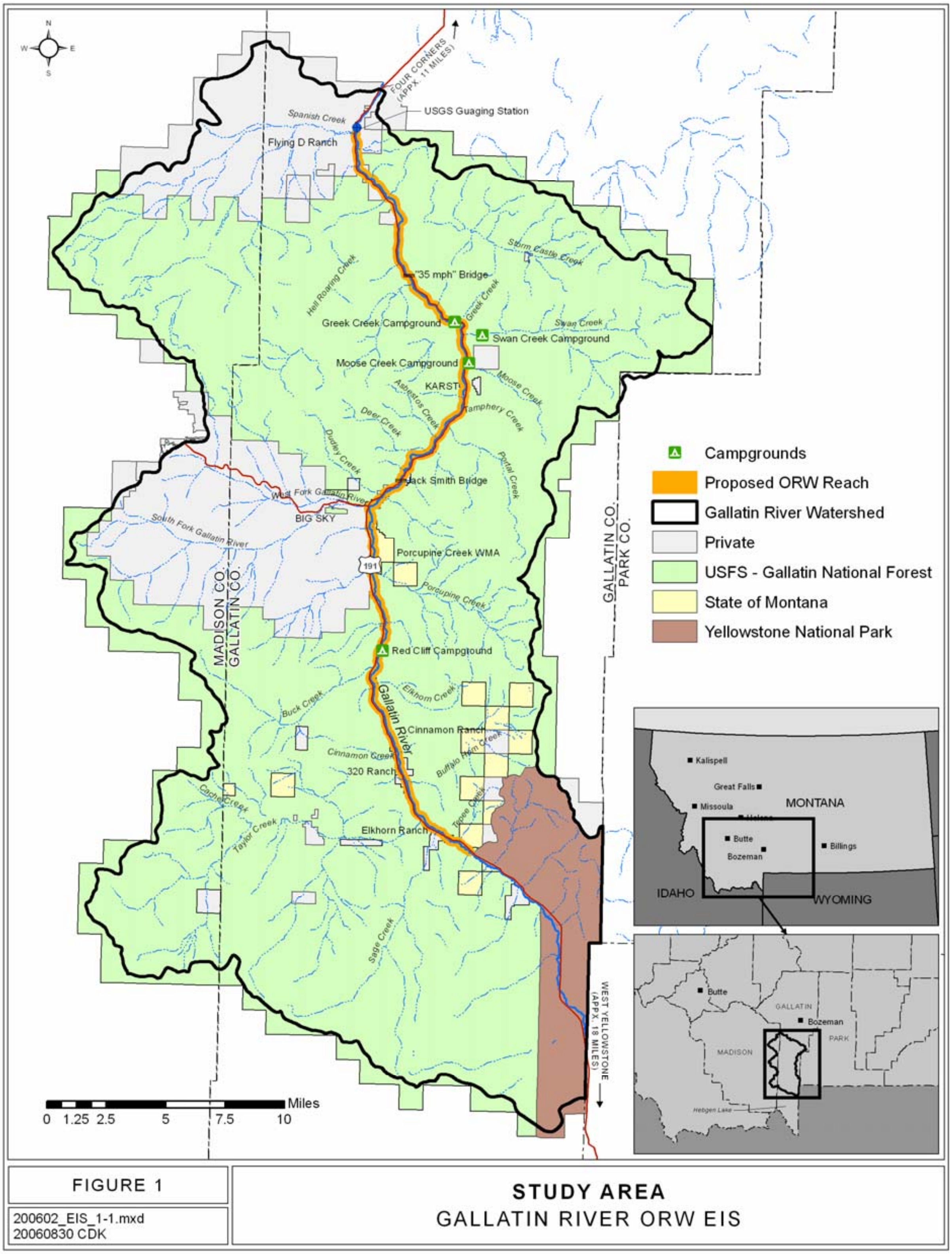

Figure 1-1. Study area for the proposed Outstanding Resource Water reach of the Gallatin River in Gallatin and Madison counties, Montana.

1.4 Other Related Environmental and Planning Documents

The Montana Department of Transportation (MDT) has released a draft Environmental Assessment (EA) for several planned safety improvement projects along U.S. Highway 191, which parallels the proposed ORW reach (DOT and MDT 2005). The proposed ORW reach of the Gallatin River flows within, or in close proximity to the Gallatin National Forest. The Forest is currently revising its 1987 Forest Plan, and has completed a draft travel plan. MEPA requires that related future actions may only be considered when these actions are under concurrent consideration by any state or federal agency through pre-impact statement studies, separate impact statement evaluations, or permit processing procedures (75-1-208, MCA).

1.5 DEQ's Responsibilities and Decisions

DEQ must prepare a thorough EIS to disclose the potential impacts of the Proposed Action, the No Action Alternative, and other reasonable alternatives to the ORW designation. DEQ will recommend a course of action in a Record of Decision (ROD) for the Board's consideration. The ROD is a concise public notice of DEQ's decision, explaining the reasons for the decision and any special conditions surrounding the decision or its implementation (Mundinger and Everts 2004). The Board will make a decision on rulemaking. Throughout the entire process, MEPA requires open disclosure and reasonable provisions for the involvement of the public in the EIS process.

1.6 Scope of Analysis

The geographic scope of this EIS includes the proposed ORW reach of the Gallatin River and the lands surrounding the river with a demonstrated hydrologic connection to the river. The hydrologic connection concept will be explained further in Chapters 2 and 4. The EIS presents descriptions of the Proposed Action and alternatives, including the Cumulative Impacts Analysis Alternative and No Action Alternative (Chapter 2); descriptions of the affected environment for all potentially affected resources (Chapter 3); and an analysis of the impacts of alternatives (Chapter 4). In addition, this EIS analyzes potential regulatory and policy changes that may occur due to ORW designation in Chapter 4.

1.7 Public Involvement Process

One of MEPA's objectives is to ensure that the public is informed of and participates in the review process (Mundinger and Everts 2004). The MEPA Model Rules require agencies to: invite public participation in the determination of the scope of an EIS; provide a 30-day public review period for the Draft EIS; and include public comments and the agency's response to substantive public comments in the Final EIS (Mundinger and Everts 2004). A public hearing on the Draft EIS will be held during the public review period.

1.8 Issues Identified During Scoping

DEQ opened the scoping period for the Gallatin ORW Designation EIS on November 25, 2005. On December 12, 2005, DEQ held a public meeting in Gallatin Gateway, Montana, at the Gallatin Gateway Community Center. Comments made at the meeting were collected by DEQ and entered into the project record, as were comments received via postal mail or e-mail. The scoping period closed on December 28, 2005.

The intent of scoping is to solicit participation from the public and interested agencies regarding the direction, breadth, and extent of the analysis contained in an EIS. Comments are evaluated based on their content and relevance and the jurisdiction of DEQ and associated agencies. Public scoping comments may redirect the analysis or assist in development of alternatives.

Twenty-six individuals or entities submitted comments, in addition to the many comments recorded at the scoping meeting. The majority of all comments were from individual citizens. Government agencies that participated in the scoping process and preparation of the EIS are identified in Chapter 6.

Several commenters addressed more than one topic or resource area. The remaining comment letters contained at least one substantive issue addressed in this section. No comments were received in the following resource areas: air quality, vegetation, and cultural resources; therefore, no issues will be discussed for these resource areas.

1.8.1 Socioeconomics

The major socioeconomics issues were nonmarket values of natural resources, costs that may result from ORW designation, and economic effects on the local economy. At least three commenters specifically mentioned that the EIS should address nonmarket values in general, and water quality, fish, and wildlife in particular. One commenter specifically mentioned non-use values as well. Most comments indicated that nonmarket values of water quality, fisheries, and wildlife were important economic elements that should be addressed in the EIS, and that these benefits were important to include to balance the cost analysis associated with ORW designation. Comments indicated these amenity values were partly the foundation of the local economy of the area.

Two commenters, including Montana Trout Unlimited (TU), asked that the costs associated with ORW designation be quantified. TU specifically asked that such costs be compared as a percentage of home construction costs. One commenter asked that the costs of not designating the reach as an ORW be examined in terms of degraded water quality.

Comments were received requesting that the effect of ORW designation on the local economy be evaluated, including specific effects of the designation on sectors of the economy such as construction, realtors, jobs, tax base, schools, etc.

1.8.2 Land Use and Recreation

Issues raised related to land use and recreation generally fell into three areas: effects on existing and future private land use; effects on existing and future public land use and projected changes in recreational use due to ORW designation. Comments related to existing private land use focused on residential development and the potential changes in DEQ approval of septic systems and other wastewater treatment systems. Concern was also expressed over potential increase in regulation of activities that generate non-point source pollution, such as logging, development, and mining.

Comments related to future private land use and development requested that the EIS characterize and quantify lands along the river designated or zoned for development, according to county land use classifications, and quantify lands that are undeveloped or “underdeveloped” (i.e., not developed to maximum intensity allowed by county zoning).

Approximately 85 percent of lands within the Gallatin River Canyon corridor are publicly owned. The U.S.D.A. Forest Service (Forest Service) is the largest land owner. Comments on land use within public lands focused on current and future mining and logging operations and on maintenance of past operations.

The Gallatin River Canyon corridor is a popular recreation site for several activities, and commenters reflected the recreational importance of the resource. For example, some commenters asked that the EIS characterize and quantify existing and projected recreational uses of the river (e.g., comparative statistics over time on river usage such as commercial rafting, guided fishing, unguided fishing, and unguided kayaking). Concern was expressed regarding whether the ORW designation would result in restrictions on existing or future river shoreline access in general, or specifically, fishing access, wildlife viewing, hiking, picnicking, camping, dog walking, mushroom hunting, commercially guided fishing and rafting, non-commercial boating activities, and use and sustainability of recreation sites. Commenters requested that the EIS consider the potential recreational benefits of an ORW designation (e.g., healthier fishery, better water quality than the No Action Alternative).

1.8.3 Water Quality

Water quality issues can be placed into six general categories: the analytical scope of the EIS; evaluations and definitions of point and non-point source discharges; questions regarding the geographic scope of the EIS; desire to see acceptable water treatment alternatives described in the EIS; concern over the effect of ORW designation on future water quality regulation; and the effect of the ongoing TMDL process.

People were generally curious about this “first ever” Montana ORW designation, how the process will work, and the potential for ORW to affect existing water quality regulations. The public was also interested in how DEQ will delineate the hydroconnectivity area that may define where septic systems would undergo a more rigorous approval process.

The Gallatin County Planning Department noted that the plans and regulations from the county do not address water quality beyond septic system approvals and required setbacks.

A comprehensive assessment of cumulative impacts was requested, including the effect of ongoing TMDLs, impacts from authorized degradation combined with nonsignificant activities for ground water connected to surface water, and surface water.

1.8.4 Fisheries and Aquatic Resources

Issues raised by the public and agency representatives generally fell into three areas: effects on the fishery; potential changes to angler populations and angler access; and use of aquatic organisms in the data review and assessment process. Other issues raised included the use of piscicides (fish poisons) in non-native fish control projects and impacts on native fishes,

including arctic grayling (*Thymallus arcticus*), which is a candidate for listing under the federal Endangered Species Act. There was also a request that the EIS include an analysis of how the ORW might affect the food web in the Gallatin, including periphyton (algae) and aquatic macroinvertebrates.

Several comments related to the recreational activities surrounding fishing will be addressed in the recreation and land use analysis. Some comments brought up the issue of potentially increased pressure on the fishery due to publicity, if the ORW designation is accepted and implemented. Another commenter asked if fishing access sites would be required to get discharge permits under the ORW.

1.8.5 Wildlife and Terrestrial Resources

Nonmarket values is a substantive issue relating to wildlife and terrestrial resources. This will be analyzed in the socioeconomics section of the EIS.

1.9 Issues Considered but Not Studied in Detail

Some comments received by DEQ requested analysis beyond the scope of the EIS, outside of the jurisdiction of DEQ, or inconsistent with the legal framework associated with the ORW petitioning process. These comments are catalogued in this section, but no further analysis will be completed.

Several comments were made regarding increasing or reducing the geographic extent of the ORW designation. The ORW reach is defined by the initial petition, and DEQ does not have the authority to change the extent of the ORW designation. Another comment requested that the EIS profile several other waters that might be eligible for ORW status. While this would be an interesting pursuit, it is not relevant to evaluating the effects of designating the Gallatin River as an ORW. Finally, several commenters requested that water quantity and effects of development on in-stream flows be analyzed. While water quantity does have some bearing on the concentration of pollutants within a water body, the ORW does not address water quantity as part of water quality; therefore, an independent analysis of water quantity would be beyond the scope of this EIS.

Some commenters listed several specific materials used in various industries that would need to be evaluated as potential point sources. While any discharge into the waters of the state may be subject to a point source permitting evaluation via the Montana Pollutant Discharge Elimination System (MPDES) program, individual chemicals and materials used on a job site (including for maintenance) are often considered potential non-point sources. Except in the incidence of accidental spills, these materials do not reach the river via any sort of conveyance, which is part of the definition of a point source (75-5-103, MCA). Non-point sources will not be controlled differently under the ORW designation.

Chapter 2: Description of Alternatives

2.1 Overview

This chapter describes the process of developing and selecting reasonable alternatives to the Proposed Action. To be considered for further study, each potential alternative had to meet the purpose and benefits of the Gallatin River ORW designation, as well as regulatory, environmental, and economic feasibility criteria. These criteria include:

- Providing the same level of water quality protection as ORW designation;
- Reasonableness; a reasonable alternative is one that is practical, technically possible, and economically feasible.

In most instances, economic feasibility of a Proposed Action is determined solely by the economic viability for "similar projects having similar conditions and physical locations and determined without regard to the economic strength of the specific project sponsor" (75-1-201, MCA). However, since this is the first proposed ORW designation, economic feasibility must be determined by weighing the costs and benefits of the Proposed Action in the context of the affected human environment.

Alternatives were evaluated and placed into the following categories:

- The No Action Alternative assumes the Board would not initiate rulemaking and the ORW designation would not proceed.
- The Proposed Action describes the ORW designation and the activities needed to implement it.
- Alternatives to the Proposed Action identifies alternatives that are reasonable and that would support the purpose and benefits of the Proposed Action. The alternatives must also be feasible from a regulatory, technical, and economic standpoint.
- Alternatives Considered and Eliminated includes alternatives that were examined but eliminated from detailed study. Alternatives discussed include watershed-based trigger values for water quality, establishment of numeric limits on residential and commercial development, and zoning restrictions.

To facilitate comparison of alternatives, background information is included on Montana's water quality laws and existing regulations to provide context on how the state currently protects water quality in the proposed ORW reach. This review is not exhaustive; rather, it provides an overview of the most pertinent regulations (Table 2-1). Montana's Water Quality Act is contained in 75-5-101 *et seq.*, MCA, and the Nondegradation Policy is found in 75-5-303, MCA, and ARM 17.30.701 *et seq*. Readers are encouraged to read the primary source material for a more complete understanding of the laws and regulations that govern water quality in Montana.

2.1.1 Development of Reasonable Alternatives

The Proposed Action is not a permitting action; however, DEQ's regulation of water quality to meet the requirements of ORW designation would have implications for future land use. Therefore, alternatives development focused on DEQ's options for protecting the water quality

of the proposed ORW reach within existing water quality laws and regulatory policy. A comparison of the regulatory aspects of the three alternatives considered in detail is provided in Table 2-2 at the end of this Chapter. Finally, a condensed description of the potential impacts is provided in Table 2-3. These impacts are detailed in Chapter 4.

Table 2-1. Summary of water quality laws and regulations related to ORW designation (Evans et al. 2002; USDA Forest Service 1987).

Regulation	Citation	Summary	Administering Agency	Date first enacted
Montana Water Quality Act	75-5-101 *et seq*., MCA	Provides guidelines to prevent, abate, and control the pollution of Montana waters in a manner consistent with national standards.	DEQ and the Board of Environmental Review (Board)	1967
Nondegradation Policy	75-5-303, MCA and ARM 17.30.701 *et seq*.	Outlines three levels of water protection, stipulating what degradation, if any, is allowable in each level.	DEQ, in accordance with Board rules and statutes	1993
Discharge Permits	Surface waters: ARM 17.30.1201 and 1301 *et seq*. Groundwater: ARM 17.30.1001 *et seq*.	Regulates anyone proposing to discharge sewage, industrial waste, or other pollutants into regulated state waters (i.e., surface, ground, or storm waters).	DEQ, in accordance with Board rules and statutes	1989
Total Maximum Daily Load (TMDL) Program	Federal Clean Water Act, Section 303(d) and 75-5-701, MCA	DEQ monitors state waters to assess the quality of those waters and to identify surface water bodies or segments of surface water bodies with threatened or impaired designated uses. DEQ is required to submit an updated list of impaired waterbodies to EPA every other year.	DEQ in association with EPA	1972
Local Boards of Health	Title 50, Chapter 2, MCA	Local boards of health safeguard public drinking water supplies by monitoring communicable diseases, waste disposal, and sewage treatment systems.	Gallatin County Board of Health makes decisions in the ORW study area.	1907
Montana Subdivision and Platting Act	Title 76, Chapter 3, MCA	Local governing bodies must evaluate subdivision's effect on agriculture, agricultural water user facilities, local services, the natural environment, wildlife and wildlife habitat, and public health and safety. The governing body may require the subdivider to reasonably minimize potentially significant adverse impacts identified through this evaluation.	Gallatin County regulates planning in the ORW study area.	1961

Table 2-1. Summary of water quality laws and regulations related to ORW designation (Evans et al. 2002; USDA Forest Service 1987).

Regulation	**Citation**	**Summary**	**Administering Agency**	**Date first enacted**
Montana Sanitation in Subdivisions Act	Title 76, Chapter 4, part 1, MCA and ARM 17.36 subchapters 1, 3, 6, 8, 9, and 11	DEQ establishes standards for review and approval of subdivisions for public and private water supplies, sewage disposal facilities, storm water drainage ways, and solid waste disposal.	DEQ and Gallatin County Environmental Health Services	1973
Streamside Management Zone Law	Title 77, Chapter 5, part 3, MCA and ARM 36.11.301 *et seq*.	An SMZ is defined in Montana as that area 50 feet from the high-water mark of a stream, with some exceptions. To safeguard such zones, timber harvests and the use of related equipment are regulated.	Department of Natural Resources and Conservation (DNRC)	1991
Agricultural Chemical Ground Water Protection Act	Title 80, Chapter 15, MCA and ARM 4.11.101 *et seq*.	Establishes and enforces agricultural chemical groundwater standards and interim numerical standards, as well as groundwater monitoring.	DEQ and the Montana Department of Agriculture	1989
Forest-Wide Standards (water quality)	Gallatin National Forest Plan, Chapter II, E, parts 10 and 16.	Manages watersheds to mitigate impacts due to land use practices. National Forest System lands within ¼ mile of the proposed ORW reach will be managed to protect wild and scenic river eligibility.	Gallatin National Forest	1987
Montana Stream Preservation Act	87-5-501 *et seq.*, MCA	Protects fish and wildlife and maintains streams and their banks and tributaries in their natural or existing state under a “124 permit.”	Department of Fish, Wildlife and Parks	1965
Montana Natural Streambed and Land Preservation Act	75-7-101 *et seq.*, MCA and ARM 36.2.401 *et seq.*	Minimizes soil erosion and protects perennial streams in their natural or existing state under a “310 permit.”	County Conservation Districts	1975

2.2 No Action Alternative

Under the No Action Alternative, the Board would not adopt a rule classifying the proposed reach of the Gallatin River as an ORW. Approving legislation would not be drafted. The No Action Alternative assumes the river would continue to be protected by current water quality laws, including existing state surface water quality standards and nondegradation policy (Table 2-1). Much of the study area falls within the Gallatin National Forest; therefore, water quality management policy on National Forest System lands would also apply. The No Action Alternative is a “status-quo” approach, which assumes that current management would continue. Nonsignificant changes and degradation in water quality could occur within this framework as identified below. The following sections describe how these regulations and policies are currently administered along the proposed ORW reach.

2.2.1 Nondegradation Review

In the absence of ORW designation, water quality regulators could approve additional point source discharges (point sources) along the proposed ORW reach providing that the dischargers met current nondegradation limits and water quality standards and completed the appropriate discharge permitting and approvals process (detailed in Section 2.2.2, below). Other potential nonpoint sources would be regulated according to current applicable requirements.

A person or entity that conducts an activity that may cause a change in existing water quality must comply with the nondegradation requirements found in ARM 17.30.701 *et seq*. If the activity is permitted, approved, licensed, or otherwise authorized, DEQ would ensure that the change in water quality is “nonsignificant” prior to issuing its permit, license, or other authorizations (ARM 17.30.706(2)). If the activity is not permitted, approved, licensed, or otherwise authorized by DEQ, the person proposing the activity may determine, based on state regulatory requirements, that the activity would not cause significant changes in water quality or may submit an application for DEQ to make the determination (ARM 17.30.706(1)).

In general, nondegradation reviews are initiated by a “new or increased source” as defined in ARM 17.30.702(18). A new or increased source refers to the load, or concentration, of pollutants, not the wastewater flow rate. Therefore, if wastewater flow of an existing source is increased, the load of pollutants must be maintained or reduced, otherwise the discharge is considered a new or increased source, and DEQ must determine if the discharge will cause an exceedence of the nondegradation water quality limits. For the proposed ORW reach of the Gallatin River, typical pollutant sources subject to nondegradation reviews include individual and community septic system, and community wastewater treatment facilities.

DEQ, in accordance with Board rules and statutes, may authorize water quality changes above the nonsignificance threshold (i.e., degradation) if a discharger demonstrates by a preponderance of evidence that:

- there are no economically, environmentally, and technologically feasible modifications to the proposed project that would result in no degradation;
- the proposed project will result in important economic or social benefits that exceed societal costs of allowing degradation;

- existing and anticipated uses of state waters will be fully protected; and
- the least degrading water quality protection practices will be used (75-5-303(3), MCA).

Once DEQ has reviewed the evidence, it issues a preliminary decision, and a 30-day public comment period begins. At the end of the comment period, DEQ issues its final decision, which may be appealed to the Board by persons who have an economic interest that might be directly affected. DEQ may review and revise authorizations to degrade once every five years and may modify the authorization as necessary. Under the No Action Alternative, permittees could continue to use this process to gain approval, even if water quality degradation would occur.

In accordance with ARM 17.36.312, subdivisions located adjacent to state surface waters require an analysis of the effects of the proposed sewage treatment systems on the quality of the nearest down-gradient high quality state surface water (DEQ 2005a). For septic systems, DEQ's nondegradation review first assesses surface water impacts in relation to the state's Numeric Water Quality Standards' trigger values (DEQ 2006a). Trigger values are used to determine if a given increase in the concentration of a toxic or nutrient parameter is "significant degradation" or "non-significant degradation" under the nondegradation rules (DEQ 2006a, ARM 17.30.715(1)(c)). If the proposed development stays below the trigger level for nutrients (nitrogen and phosphorus), it is considered to be in compliance with the nondegradation policy. If the development exceeds the trigger values for nitrogen and phosphorus, the proponent can evaluate the surface water impacts via the narrative standard (DEQ 2005a; ARM 17.30.715(1)(g)). If the discharge of phosphorus can meet the 50-year breakthrough requirement (ARM 17.30.715(1)(e)), then the trigger level analysis is not required for phosphorus for subdivisions adjacent to state surface waters. DEQ has had sites fail the trigger value calculation, but then pass a nondegradation review by meeting the narrative standard through surface water modeling (E. Regensburger, pers. comm. 2005). Under the No Action Alternative, permittees could continue to use this process to gain approval. Each trigger value analysis is independent of previous and subsequent reviews; therefore, the additive impact of several projects could exceed the trigger value, despite individual projects "passing" the trigger level criteria.

2.2.2 Discharge Permits

Anyone proposing to discharge sewage, industrial waste, or other pollutants into state waters must apply for a discharge permit. Permitting guidelines differ for discharges to surface waters versus groundwater. Point sources to surface waters are permitted via the Montana Pollutant Discharge Elimination System (MPDES) process. Unless an authorization to degrade is obtained, DEQ can only authorize changes in water quality that meet the nondegradation nonsignificance limits and water quality standards for a pollutant via an MPDES permit. The Montana Water Quality Act defines some activities that do not require a discharge permit including:

- agricultural irrigation facilities;
- storm water disposal; and
- subsurface disposal systems for sanitary wastes serving individual residences.

The complete list of groundwater discharges that do not require a discharge permit can be found in 75-5-401, MCA.

Discharge permits may be issued for up to five years, and if a permittee reapplies, the renewal process includes a thorough review. DEQ can revoke or suspend a discharge permit if it finds that the discharge is violating the Water Quality Act (75-5-404, MCA). There are two existing MPDES permits in the proposed ORW reach of the Gallatin River. These permits could be renewed or expanded under the No Action Alternative in accordance with the regulations described in this section.

DEQ can require monitoring as part of a discharge permit, and can inspect the premises of a discharger at reasonable times (75-5-602 and 603, MCA). In the case of a violation, the Board can develop enforcement procedures for DEQ to follow, and can preside over enforcement hearings.

2.2.3 Subdivision Wastewater Approval

In Montana, two laws regulate subdivision activity, including wastewater treatment: the Montana Subdivision and Platting Act and the Montana Sanitation in Subdivisions Act. Both laws have lists of exemption circumstances for which the requirements of the Acts do not apply, and in some cases neither Act may apply (Gallatin County 2004 and 2001). Even in cases where neither Act applies, wastewater treatment systems within Gallatin County are regulated under the Gallatin City-County Regulations for Wastewater Treatment Systems (Gallatin County 2004). In all subdivision application cases, DEQ conducts a nondegradation review, but the Gallatin County Planning Department also evaluates the proposed development.

Within the proposed ORW reach, the Gallatin County Planning Department is the primary regulating agency for subdivisions. With some exceptions, and according to county regulations, an Environmental Assessment (EA) must be prepared for each subdivision. The EA must include:

- a description of every surface water body that may be affected by the proposed subdivision;
- available groundwater information; and
- a community impact report that addresses the need for water and sewage facilities.

Under the No Action Alternative, the Gallatin County Planning Department would evaluate the potential effect of a new subdivision within the Gallatin ORW watershed on agriculture, agricultural water user facilities, local services, the natural environment, wildlife and wildlife habitat, and public health and safety. The Gallatin County Planning Department may refer the subdivision application to other agencies and interested entities for review (Gallatin County Planning Department 2005). The Gallatin County Planning Department may require the subdivider to reasonably minimize potentially significant adverse impacts. This process serves as a means to regulate the impacts of development on society and the natural environment, and to provide under existing Montana law some protection to the quality of Gallatin River water.

Gallatin County Environmental Health Services also reviews wastewater treatment systems. Under the No Action Alternative, individual wastewater treatment systems, or septic systems, would be reviewed by the agency. Within Gallatin County, a person needs to hold a valid "permit to construct" issued by Gallatin County Environmental Health Services for the specific

construction, repair, replacement, or alteration of any wastewater treatment system (Gallatin County 2004). County regulations make it unlawful to operate an obsolete wastewater treatment system within Gallatin County, and require that any new installation, repair, replacement, or alteration of any portion of an existing system meet current regulations for location, design, and construction of a wastewater treatment system. Under the No Action Alternative, subdivisions would continue to be evaluated by these agencies, using current regulations and provisions.

2.2.4 Setbacks

A "setback" is a minimum distance from a watercourse. Generally, setbacks are measured from the mean high water line. The mean high water line is defined as "the line which the water impresses on the soil by covering it for sufficient periods to deprive it of vegetation" (Gallatin County Board of Commissioners 2001). Setbacks can be used by planning departments and government agencies to regulate development within a floodplain or to limit impacts to the bed and banks of watercourses. Within the Big Sky zoning district in Gallatin County, all buildings and site improvements must maintain a minimum setback of 100 feet from the annual mean high water line of the Gallatin River and 50 feet from the annual mean high water line for all other streams (Gallatin County 2002). Land use within these setbacks is limited to the planting of native riparian vegetation, agricultural uses (with the exception of structures), maintenance of existing nonnative vegetation, and the control and maintenance of noxious weeds, deadfall, and selected pruning. Removal of existing native vegetation within the setback area is not permitted.

Setbacks and their implications for land use and planning are discussed in greater detail in the Land Use section of Chapter 3. Under the No Action Alternative setbacks would continue to apply to all buildings and site improvements consistent with respective zoning district regulations.

2.2.5 Water Quality on Public Lands

Under the 1987 Gallatin National Forest's Forest Plan, the Gallatin River from the National Forest Boundary to Yellowstone National Park was found to meet the eligibility requirements for Wild and Scenic River status as a "recreational river" (USDA Forest Service 1987). This reach contains the entire proposed ORW section of the river (Figure 1-1). The lands one-quarter of a mile from the banks along the eligible reach of the Gallatin River are to be managed to "provide protection of eligible river segment areas until future suitability studies are completed" (USDA Forest Service 1987). This forest-wide standard precludes development of new low dams, rip-rap, other flood-control structures, or diversions along the proposed ORW reach (USDA Forest Service 1987). However, it does not prohibit establishment of new roads, campgrounds, picnic areas, timber harvest, or mineral development.

All proposed on-the-ground actions within the Gallatin National Forest are reviewed under the Forest Service NEPA process and would be evaluated for consistency with Forest Plan requirements. In addition, activities on National Forest System lands that impact state waters are subject to the same DEQ and county agency review process as activities on private lands.

There are some state-owned lands along the proposed ORW reach. These lands are managed by Montana Fish, Wildlife and Parks and by the Montana Department of Natural Resources and Conservation. As is the case for federal agencies, all Montana agencies must comply with state

water quality regulations. Therefore, activities on state-owned lands that would impact state waters are subject to the same DEQ and county agency review process as activities on private lands.

2.3 Proposed Action Alternative

Under the Proposed Action Alternative, the Board would proceed with formal rulemaking to designate the Gallatin River as an ORW from the Yellowstone National Park boundary to the confluence with Spanish Creek and would draft a bill for the Legislature to approve the rule. Under the Proposed Action Alternative, DEQ could not grant an authorization to degrade the section of the Gallatin River proposed for ORW status for any activity (75-5-316(2), MCA). In addition, under ORW designation, DEQ could not allow a new or increased point source that would result in a permanent, measurable change in the water quality of the proposed ORW river section. A permanent change would be like that created by a wastewater treatment plant discharge. A temporary change in water quality would be like that caused by digging a pipeline trench across a stream. Point sources with treatment systems that purify effluent, to a state as clean as the current level of water quality in the ORW reach, could still be permitted by DEQ.

The guidelines for identifying a point source are clear, as defined in the Montana Water Quality Act (75-5-103(24), MCA). However, the ORW designation also addresses other pollutant sources presently reviewed by DEQ that have a potential to degrade the water quality of a designated water body. Therefore, DEQ must determine how to evaluate potential sources in an objective, scientifically defensible manner, consistent with existing water quality regulations and laws. The following sections describe how these evaluations would take place under the Proposed Action Alternative.

2.3.1 Nondegradation Review

Under the Proposed Action, DEQ would conduct its water quality impact reviews of new or increased discharges to the ORW segment of the Gallatin River using a procedure similar to that currently used for nondegradation reviews. If a proposed subdivision development or other project, in conjunction with other new or increased discharges to the ORW segment, were found to exceed trigger values for any numeric water quality parameter in the proposed ORW segment, the project would not be approved. Trigger values are the concentration increases of a pollutant that are defined as significant water quality degradation [ARM 17.30.715(1)(c)]. This initial test of significance is different from that currently used for a nondegradation review because the nondegradation trigger level review is based on impacts due to each individual project, instead of cumulative effects of multiple projects. Under the Proposed Action Alternative, a project proponent could pursue alternative management practices or water treatment methods to reduce pollutant loads, but could not pursue approval under the narrative standard, as is currently allowed under nondegradation rules for nutrients, if the trigger value were exceeded. In addition, under the Proposed Action Alternative, DEQ could not issue an authorization to degrade, nor could it review the discharge under the criteria that it is nonsignificant degradation if the discharge does not create a concentration outside of a mixing zone that exceeds 15% of the lowest applicable water quality standard [ARM 17.30.715(1)(c)].

It should be noted that many pollutants do not have a trigger value. In such cases DEQ would have to determine, on a case-by-case basis, the value defined as a measurable change for each pollutant in the discharge.

As noted in the discussion for the No Action Alternative, subdivisions adjacent to state surface waters require an analysis of the effects of the proposed sewage treatment systems on the quality of the nearest down-gradient state surface water in accordance with ARM 17.36.312. DEQ's subdivision nondegradation guidance document defines proximity to surface waters as a direct hydrologic connection to the water in question (DEQ 2005a). Determining whether a discharge is in direct hydrologic connection to the surface water is site-specific and depends on geology, hydrogeology, volume of the discharge, sensitivity of the surface water, and other site properties (DEQ 2005a). New or increased discharges on properties with a direct hydrologic connection to the proposed ORW reach of the Gallatin River could not be approved if the water quality impacts review showed that these actions, in conjunction with other affected new or increased discharges, would exceed trigger values in the ORW segment of the Gallatin River. Lands along the proposed ORW reach that have a direct hydrologic connection to the Gallatin River have been delineated based on geology, soil type, distance from the river's banks, and height above the river's surface. These lands are referred to as the "footprint" throughout this document (Figure 2-1). The water quality section of Chapter 4 describes the methods used to define the footprint.

Under the Proposed Action Alternative, new or increased point sources to the proposed ORW segment that would be permitted, authorized, licensed, or approved by DEQ on lands within the footprint would require a water quality impact review. Those water quality impact reviews would be used to verify that there would be no permanent change in the designated ORW. Compliance with the trigger value limit for each parameter would be based on pounds per acre load calculated to assure conforming in-stream concentration increases after stream dilution at the downstream end of the proposed ORW reach at the confluence with Spanish Creek. This approach calculates the total load available and then allocates it along all developable lands inside the footprint. Therefore, the trigger will not be approached until the entire load is allocated, or until all of the developable lands remaining are developed. This approach is a conservative one that will ensure that DEQ can protect the water quality of the proposed ORW reach while treating each future developer equally, regardless of when they decide to develop their property.

Phosphorus and nitrogen/nitrate are the two major pollutants generated by septics and wastewater treatment systems. The following is a summary of the nutrient loading analysis conducted as part of the alternatives development for this Draft EIS. The complete description of the analysis, calculation, assumptions, and conclusions is provided in Appendix A. Based on the nutrient loading calculated for the proposed ORW reach of the Gallatin River, phosphorus is the limiting factor for nutrient loading. The analysis (see Appendix A) assumes 100% of the phosphorus or nitrate reaches the receiving water, and does not account for attenuation of these pollutants through mechanisms such as soil adsorption and plant photosynthesis.

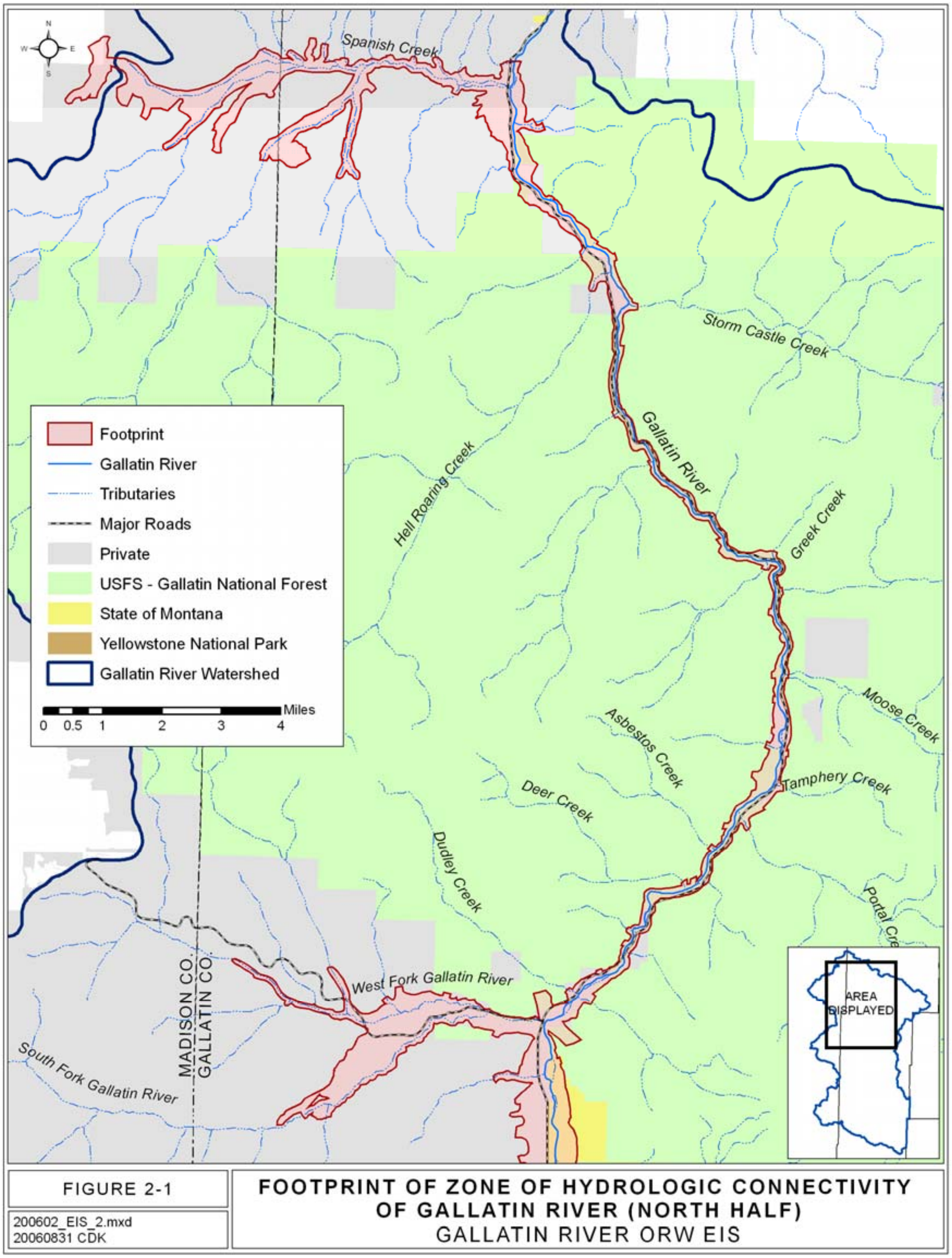

Figure 2-1. Map showing the footprint of the area hydrologically connected to the mainstem of the Gallatin River based on a one year groundwater travel time.

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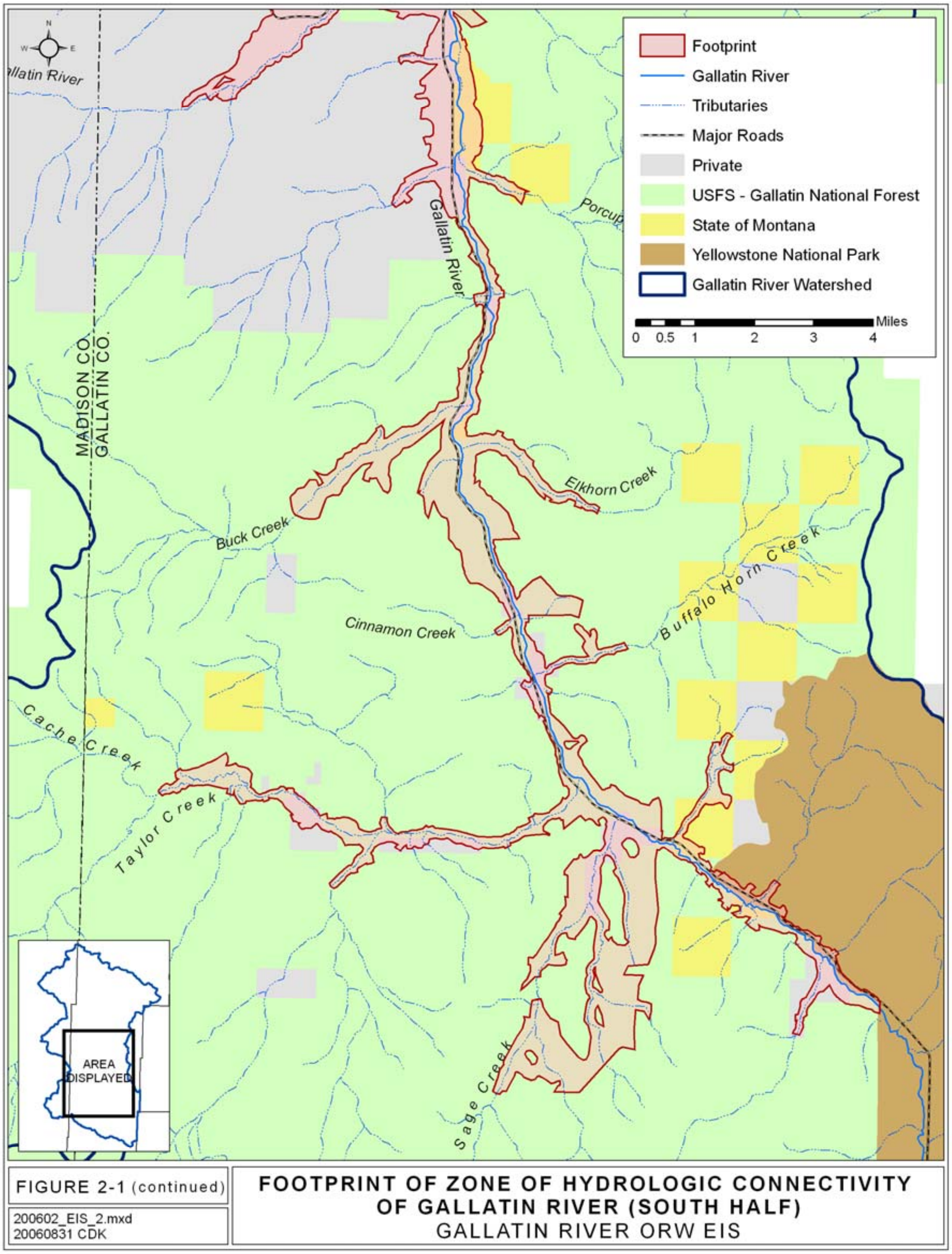

Figure 2-1 (continued).

Using the trigger value for phosphorus of 0.001 mg/l and the calculated 7-day 10-year low flow value (7Q10) on the Gallatin River at Gallatin Gateway of 204 cfs (McCarthy 2005), a maximum annual loading in the proposed ORW reach of the Gallatin River to meet the trigger value at the Spanish Creek confluence would be 400.78 lbs of phosphorus as P (Appendix A).

In a similar fashion, using the trigger value for nitrate of 0.01 mg/l as N and the 7Q10 value, the maximum annual loading of nitrate would be 4,007.80 lbs as N (Appendix A).

Based on the footprint analysis overlaid on the undeveloped acreage categorized by existing land use, there are approximately 1,846 acres of undeveloped land within the footprint (Figure 2-1). Allocating the pounds of phosphorus and nitrate over that acreage, there is a limit of 0.217 lbs P/acre/year and 2.17 lbs nitrate as N/acre/year. Using amounts of 4.93 lbs P per single family equivalent per year and 23.33 lbs N per single family equivalent per year for a conventional wastewater treatment system (consisting of a septic tank and drainfield), the acres needed for a single family equivalent are 22.69 undeveloped acres for phosphorus and 10.75 undeveloped acres for nitrate as N. Therefore, to pass a water quality impacts review under the Proposed Action Alternative, a proposed home (single family equivalent) with a conventional wastewater treatment system inside the footprint would need to have a minimum lot size of 22.69 acres. Several wastewater treatment alternatives are available that can significantly reduce nitrogen and phosphorus content. Use of one or more of these alternatives could allow proposed homes to be built on lots smaller than 22.69 acres. Available wastewater treatment alternatives and their costs are detailed in Chapter 4.

2.3.2 Discharge Permits

MPDES discharge permits are reserved for point sources. Under the Proposed Action Alternative, DEQ cannot allow a new or increased point source that would result in a permanent change (degradation) in the water quality of an ORW (75-5-316, MCA). The Proposed Action Alternative would not prohibit new point sources, but it would likely require new or increased point sources to discharge cleaner water than could be permitted under the No Action Alternative. The Proposed Action Alternative would not invalidate or curtail existing permitted point sources.

2.3.3 Subdivision Wastewater Approval

The Proposed Action Alternative would not affect how the Gallatin County Environmental Health Services or the Gallatin County Planning Department review subdivision wastewater treatment systems applications. Proposed subdivisions with wastewater discharges inside the footprint for the proposed ORW reach would undergo a water quality impact review by DEQ to determine compliance with the ORW requirements outlined above under the nondegradation review section. Renovations to existing wastewater discharge systems would need to meet or exceed the requirements of their existing approvals. New, increased, or existing wastewater systems with discharges outside the footprint would not be affected by the Proposed Action Alternative.

2.3.4 Setbacks

Under the Proposed Action Alternative, there would be no changes to the setbacks imposed by Gallatin County in any of the zoning districts. The footprint is not a setback; it is an outline of

the zone of direct hydrologic connectivity. Buildings could be constructed inside the footprint, but they would undergo a water quality impact review if they included any discharge to ground or surface waters, such as a septic system.

2.3.5 Water Quality on Public Lands

Federal and state agencies must comply with all state water quality regulations. Therefore, the Proposed Action Alternative would not change the way actions are permitted or approved on state and federal lands outside of the footprint. However, proposed actions within the footprint would require a water quality impact review if they include any discharge to ground or surface waters, such as a septic system.

2.4 Cumulative Impacts Analysis Alternative

Under the Cumulative Impacts Analysis Alternative, DEQ would exercise its discretionary authority to assess the cumulative impacts to water quality of developments over time. The authority to include cumulative impacts analysis in nondegradation reviews is found in ARM 17.30.715(2):

> "Notwithstanding compliance with the criteria of (1), the department [DEQ] may determine that the change in water quality resulting from an activity which meets the criteria in (1) is degradation based upon the following:

a) cumulative impacts or synergistic effects;
b) secondary byproducts of decomposition or chemical transformation;
c) substantive information derived from public input;
d) changes in flow;
e) changes in the loading of parameters;
f) new information regarding the effects of a parameter; or
g) any other information deemed relevant by the department and that relates to the criteria in ARM 17.30.715(1)."

Current policy, as described under the No Action Alternative, is to evaluate surface water impacts of each application independent of other past and pending applications. DEQ already has the authority to implement a cumulative impacts analysis in any watershed in the state; however, the level and pace of development in most watersheds across Montana has not necessitated surface water cumulative impacts analysis in order to effectively protect water quality. As the pace of development escalates, the nutrient loading baseline used by County Environmental Health Services and DEQ to measure the incremental impact of each additional development becomes increasingly dynamic. If several developments come up for review at the same time, it is difficult for DEQ to determine the impacts of granting one permit in the context of several other pending permits.

2.4.1 Nondegradation Review

The change to the nondegradation review process under the Cumulative Impacts Analysis Alternative would be similar to that described under the Proposed Action Alternative (Section 2.3.1). Each development requiring a nondegradation review would be evaluated in the context of existing pollutant loads to the proposed ORW reach. Under this alternative DEQ would need

to assess the incremental impact of each development in the context of past and pending developments.

Application of the Cumulative Impacts Analysis Alternative to the nondegradation review process would be very similar to that described under the Proposed Action Alternative. DEQ would use the footprint described under the Proposed Action Alternative analysis (Chapter 4) to determine whether a surface water cumulative impacts nondegradation review would be necessary. Surface water cumulative impacts analysis would only apply to those applications that required a surface water nondegradation review (i.e., projects within the footprint). The loading levels calculated and described in Chapter 4, “Analysis of Alternatives” would be applicable to this alternative as would the types and levels of mitigation for wastewater treatment. These prescribed loading levels would allow DEQ a level of confidence in assessing each development given that the pace and intensity of development is difficult to predict. If an application was denied on the basis of the cumulative impacts trigger value assessment, the permittee could apply for an authorization to degrade under the Cumulative Impacts Analysis Alternative. This alternative would also allow evaluation using the narrative standard as provided under the No Action Alternative, but unlike the No Action Alternative, it would require cumulative impacts analysis of past and proposed unrelated developments in the analysis of the narrative standard.

2.4.2 Discharge Permits

The Cumulative Impacts Analysis Alternative would assess new discharge permits or point sources using the same type of analyses as described above under the Proposed Action Alternative. Any new point sources would be evaluated in terms of their incremental increase to pollutant loads given the context of the current water quality in the proposed ORW reach. The Cumulative Impacts Analysis Alternative would not prohibit new point sources, but it would likely require new or increased point sources to discharge cleaner water than could be permitted under the No Action Alternative. The Cumulative Impacts Analysis Alternative would not invalidate or curtail existing permitted point sources.

2.4.3 Subdivision Wastewater Approval

The Cumulative Impacts Analysis Alternative would not affect how the Gallatin County Environmental Health Services or the Gallatin County Planning Department reviews subdivision wastewater treatment systems applications. Proposed subdivisions with wastewater discharges inside the footprint for the proposed ORW reach would undergo a cumulative impacts nondegradation review for both groundwater and surface water. Each development would be evaluated cumulatively in the context of existing pollutant loads. Renovations to existing and pending wastewater discharge systems would need to meet or exceed the requirements of their existing approvals. New, increased, or existing wastewater systems with discharges outside the footprint would not be affected by the Cumulative Impacts Analysis Alternative.

2.4.4 Setbacks

Under the Cumulative Impacts Analysis Alternative, there would be no changes to the setbacks imposed by Gallatin County in any of the zoning districts. The footprint is not a setback; it is an outline of the zone of direct hydrologic connectivity to the ORW. Buildings could be constructed inside the footprint, but they would undergo a water quality impacts review if they included any discharge to ground or surface waters, such as a septic system.

2.4.5 Water Quality on Public Lands

Federal and state agencies must comply with all state water quality regulations; therefore, no alternative would change the way actions are permitted or approved on state and federal lands outside of the footprint. Agency-proposed actions within the footprint would require a water quality impacts review if they include any discharge to ground or surface waters, such as a septic system. The Cumulative Impacts Assessment Alternative would review any potential water quality impacts in the context of other past and concurrently proposed actions.

2.5 Modified and/or Mitigated Alternatives

In order to approve the petition for ORW designation, the Board had to determine that the petition made a reasonable case that no other alternatives existed that would provide the same level of protection to the proposed ORW reach of the Gallatin River. The Board's approval of the petition initiated the EIS process and a more rigorous examination of potential alternatives. After careful examination of the existing laws and water quality protection procedures, DEQ concurs that there are no modified or mitigated alternatives within the existing legal and regulatory framework that would provide the same level of water quality protection as ORW designation.

2.6 Related Future Actions

Agency and governmental actions that have the potential to affect, or be affected by, the Proposed Action, that are planned or are in the active planning process include the MDT reconstruction of portions of U.S. Highway 191 in the Gallatin Canyon, the revision of the Gallatin National Forest's Forest Plan, and the renewal of the Big Sky Water and Sewer District's MPDES permit. There are no potential point sources in the U.S. Highway 191 reconstruction project (DOT and MDT 2005). At the time of construction, MDT will have to comply with all existing water quality regulations. Therefore, under any alternative, MDT will need to coordinate with DEQ on the applicable best management practices for controlling inputs to the Gallatin River during roadwork. MDT will need to submit the appropriate permit applications for review by DEQ and other involved agencies. Although nonpoint sources do not require additional regulation under the proposed ORW, it is likely that DEQ will require strict adherence to Best Management Practices (BMP) guidelines in order to reduce the likelihood of nonpoint sources causing degradation to water quality in the proposed ORW reach.

Revisions to the forest plan will define resource management practices within the Gallatin National Forest over the next several decades. However, any on-the-ground actions within the Gallatin National Forest with the potential to impact state waters will follow the same permitting and approvals process as actions on private lands. In addition, the Forest Service will review all on-the-ground actions internally via its NEPA process, which provides for public and agency comment. Potential water quality degradation from activities within the Gallatin National Forest such as timber harvest, mining and associated road building generally fall under the category of non-point source pollution. Long-term water quality impacts due to sedimentation from erosion of unvegetated roadsides, unstable road cuts, or stream crossings would require review by DEQ. However, short-term, non-point source impacts would continue to be managed using BMPs and would not require permitting or monitoring beyond current practices under any alternative.

The Big Sky Water and Sewer District (District) holds a MPDES permit to discharge treated wastewater to the proposed ORW reach of the Gallatin River. The District currently stores its wastewater during winter and applies it to golf courses during summer. Therefore, the District does not use its discharge capacity to the Gallatin River under its MPDES permit. The District's MPDES permit has been administratively extended while DEQ prepares a draft of the renewed permit. If the Proposed Action Alternative is implemented, the District could continue to operate under the terms of its renewed MPDES permit, but could only increase its discharge load to the Gallatin River in the future within the limits of the Proposed Action Alternative.

2.7 Alternatives Considered but Dismissed

In developing the Proposed Action Alternative, DEQ considered several methods for implementing existing water quality regulations within the footprint along the proposed ORW reach. One alternative to the Proposed Action identified during public scoping was to classify the Gallatin River as a Wild and Scenic River. This alternative was dismissed for reasons described below. Two implementation alternatives were developed, but then dismissed as discussed below.

2.7.1 Classification as a Wild and Scenic River

During the scoping process, the public suggested pursuing Wild and Scenic River designation instead of ORW designation. The Wild and Scenic Rivers Act was passed in 1968 and has since been amended to add additional rivers and adjust its policies (16 U.S.C. 1271-1287). The purpose of the Wild and Scenic Rivers Act is to preserve rivers "in free-flowing condition to protect the water quality of such rivers and to fulfill other vital national conservation purposes" (16 U.S.C. 1271-1287). "Free-flowing" is defined as "existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway."

There are three Wild and Scenic River classifications: wild, scenic, and recreational. The proposed ORW reach of the Gallatin River qualifies as a recreational river because of the presence of U.S. Highway 191 and extensive tracts of private lands along its corridor (USDA Forest Service 1987).

The Wild and Scenic Rivers Act creates federal water rights to flows of protected river segments necessary to carry out the Wild and Scenic designation purposes, such as maintaining in-stream flows. The water right is to water not otherwise allocated under state law, but with the additional power of the federal government to condemn rights vested under state law if necessary to accomplish the federal purposes (NPS 2005). In the context of Montana water law, these rights would have to be junior (more recently established) to existing water rights, but the federal right to condemn would give the agency the right to purchase senior water rights if those rights were needed to maintain flows.

The Wild and Scenic Rivers Act states: "The jurisdiction of the States over waters of any stream included in a national wild, scenic or recreational river area shall be unaffected by this Act to the extent that such jurisdiction may be exercised without impairing the purposes of this Act or its administration" (16 U.S.C. 1271-1287, Section 13). Therefore, the Wild and Scenic Rivers Act focuses on water quantity and not water quality. Although the intent of the Act is to protect the water quality of wild and scenic rivers and to fulfill other vital national conservation purposes,

there are no specific limitations on pollutant sources or guidelines for water quality management (16 U.S.C. 1271-1287). By retaining state jurisdiction over the waters, the Wild and Scenic Rivers Act looks to state agencies to manage water quality. Therefore, designation as a Wild and Scenic River would not provide the same level of water quality protection as ORW designation. Rivers can be designated wild and scenic only by act of Congress. They can also be designated by an act of a state legislature, with approval by the Secretary of the Interior upon application by the governor (16 U.S.C. 1273). Therefore, the Board does not have the authority to pursue this alternative to the Proposed Action.

2.7.2 Watershed-based Trigger Values

In developing the Proposed Action Alternative, the idea of dividing the footprint of the proposed ORW reach into subwatersheds was considered. The Gallatin River watershed encompassing the proposed ORW reach was divided into five subwatersheds. The subwatersheds were delineated based on major stream confluences. Each subwatershed encompasses all of the lands drained by that stream. Watershed delineation follows the ridgelines or highpoints that define which way a drop of water would flow, and which stream it would eventually enter as it moves downhill. Three were delineated along the mainstem of the Gallatin River: from the Yellowstone National Park boundary to Buffalo Horn Creek (including Taylor Fork Creek); from Buffalo Horn Creek to Portal Creek; and from Portal Creek to the confluence with Spanish Creek (Figure1-1). The West Fork Gallatin River and the Spanish Creek watersheds were also considered subwatersheds. These subwatersheds are equivalent to the U.S. Geological Survey’s 5th code Hydrologic Units (HUCs).

The intent of this analysis was to evaluate pollutant loading within each subwatershed and calculate the allowable loads that would not exceed the trigger values for the mainstem of the river in the proposed ORW reach. The amount of biological uptake or attenuation of pollutants in each subwatershed would be estimated to determine how much of the pollutant load was used up once it entered the river. The biological attenuation, i.e., the breakdown of organic contaminants into smaller compounds by microbial organisms, would reduce contributions towards the trigger values as the waters flowed downstream. The microbial organisms transform the contaminants through metabolic or enzymatic processes, frequently producing carbon dioxide or methane.

This alternative was dismissed because biological attenuation would have to be modeled mathematically and would vary greatly depending on the season of the year, water temperature, water flow, and the types and amounts of biological organisms in the reaches. Biological attenuation would likely be minimal during the winter months when residential occupation levels and, consequently, wastewater output are highest in the West Fork Gallatin River subwatershed.

DEQ believes that such a model would be difficult to construct, and that implementing different trigger values for each reach would lead to confusion among potential land users and conflict among regulatory agencies. In addition, the inherent variability in the model would make it impossible to calibrate definitively. Therefore, DEQ’s confidence in the model’s ability to accurately identify appropriate loading estimates was too low to support this alternative.

2.7.3 Development Unit Limits

Dividing the total allowed pollutant load into single family equivalents was also considered. Under this alternative, DEQ would calculate the number of additional single family equivalents that would result in a pollutant load equal to the trigger value as measured at the confluence of the Gallatin ORW with Spanish Creek. The single family equivalent limit would only apply to lands within the footprint. Lands outside of the footprint would be regulated in accordance with existing water quality and zoning regulations. Each single family equivalent translates into one home or housing unit; therefore, DEQ would limit the total number of homes inside the footprint to the calculated single family equivalent maximum. DEQ would then oversee this limit by coordinating water quality impact reviews and building permits in appropriate zoning districts. Once the single family equivalent maximum was reached, no subsequent homes or septic systems would be allowed inside the footprint.

However, DEQ does not have the authority to regulate development or impose zoning regulations. The per acre loading limit approach described under the Proposed Action Alternative would enable DEQ to limit pollutant contributions in a manner consistent with current regulations and treat each potential development equally throughout the watershed. This alternative was dismissed because a more feasible alternative existed that would not require a change in the regulations and authority exercised by DEQ.

Table 2-2. Comparison of the regulatory aspects of the three alternatives carried forward for analysis.

Regulation	**Citation**	**No Action**	**Proposed Action**	**Cumulative Impacts Analysis**
Montana Water Quality Act	75-5-101 *et seq.*, MCA	DEQ could issue a permit or approval of an activity that would degrade the existing water quality. However, water quality could not be degraded below current state standards.	DEQ could not issue a permit or approval of an activity that would cause permanent change in the existing water quality.	Same as No Action
Nondegradation Policy	75-5-303, MCA and ARM 17.30.701 *et seq.*	DEQ could approve new and increased point sources providing that the dischargers met current guidelines and completed the appropriate discharge permitting and approvals process. The DEQ may grant an authorization to degrade if a discharger demonstrates by a preponderance of evidence that: • there are no economically, environmentally, and technologically feasible modifications to the proposed project that would result in no degradation; • the proposed project will result in important economic or social benefits that exceed societal costs of allowing degradation; • existing and anticipated uses of state waters will be fully protected; and • the least degrading water quality protection practices will be used (75-5-303(3), MCA).	ORW designation would preclude DEQ granting an authorization to degrade under 75-5-303, MCA for all types of new and increased point sources that require a nondegradation review. DEQ nondegradation review would assess surface water impacts in relation to the State's Numeric Water Quality Standards. A proposed development would pass nondegradation review if cumulative impacts stay below numeric trigger levels. Narrative standards would not be an option under ORW designation.	DEQ could approve new and increased point sources providing that the nondegradation review found that the new or increased point source did not exceed the appropriate trigger value when evaluated it in the context of cumulative impacts with other new developments. The authorization to degrade process would remain unchanged from that described under the No-Action. The criteria for the application of narrative standards would also remained unchanged from that described under the No Action.

Table 2-2. Comparison of the regulatory aspects of the three alternatives carried forward for analysis.

Regulation	**Citation**	**No Action**	**Proposed Action**	**Cumulative Impacts Analysis**
		DEQ nondegradation review for septic systems, would assess surface water impacts in relation to the State's Numeric Water Quality Standards trigger values. A proposed development would pass nondegradation review if impacts stay below the numeric trigger level. If the development exceeds the trigger value, the proponent has the option of looking at the surface water impacts via the narrative standard through surface water modeling.		
Discharge Permits	Surface waters: ARM 17.30.12 and 13 Ground water: ARM 17.30.10	Proposed discharge of sewage, industrial waste, or other pollutants into regulated state waters (i.e., surface, ground, or storm waters) will require a discharge permit. DEQ could issue a discharge permit that would degrade the existing water quality. However, water quality could not be degraded below current state standards.	Permit application process and standards would remain unchanged. DEQ could not issue a discharge permit that would cause measurable (i.e., permanent) change in the existing water quality.	Permit application process and standards would remain unchanged. DEQ could issue a discharge permit that would degrade the existing water quality. However, water quality could not be degraded below current state standards.
Total Maximum Daily Load (TMDL) Program	Federal Clean Water Act, Section 303(d) and 75-5-701, MCA	No Change	No Change	No Change
Local Boards of Health	50-2, MCA	No Change	DEQ may want to coordinate with the Board of Health on review and approval of new septic systems	No Change

Table 2-2. Comparison of the regulatory aspects of the three alternatives carried forward for analysis.

Regulation	Citation	No Action	Proposed Action	Cumulative Impacts Analysis
Montana Subdivision and Platting Act	76-3, MCA	No Change	Need for increased coordination between DEQ and local planners to assess potential cumulative impacts of upcoming subdivisions	Need for increased coordination between DEQ and local planners to assess potential cumulative impacts of upcoming subdivisions.
Sanitation in Subdivisions Act	76- 4 (1), MCA and ARM 17.36	No Change	Need for increased coordination between DEQ and Local Environmental Health Services to keep track of all pending septic approvals.	Need for increased coordination between DEQ and Local Environmental Health Services to keep track of all pending septic approvals.
Streamside Management Zone Law	77- 5 (3), MCA and ARM 36.11.3	No Change	No Change	No Change
Agricultural Chemical Ground Water Protection Act	80-15, MCA and ARM 4.11	No Change	No Change	No Change
Forest-Wide Standards (water quality)	Gallatin National Forest Plan, Chapter II, E, parts 10 and 16.	No Change	No Change	No Change
Montana Stream Preservation Act	87-5-501 *et seq.*, MCA	No Change	No Change	No Change
Montana Natural Streambed and Land Preservation Act	75-7-101 *et seq.*, MCA and ARM 36.2.401 *et seq.*	No Change	No Change	No Change

Table 2-3. Condensed description of potential impacts related to the three alternatives considered in detail in the Gallatin River Outstanding Resource Water Designation Draft Environmental Impact Statement.

Potential Impact **(PI) = Primary** **(SI) = Secondary** **(CI) = Cumulative**	**Common to All Action Alternatives**	**Alternative 1: No Action**	**Alternative 1: No Action with Mitigation Measures**	**Alternative 2: Proposed Action**	**Alternative 2: Proposed Action with Mitigation Measures**	**Alternative 3: Cumulative Impacts Analysis**	**Alternative 3: Cumulative Impacts Analysis with Mitigation Measures**
Hydrology							
Water quality - general	**(PI)**: Water quality standards remain same.	**(PI):** Nondegradation standards for phosphorus and nitrogen remain numeric and narrative. Regulated under the existing rules of DEQ and counties. Local governments required comply with nondegradation requirements that are not part of State's review. Additional nutrient loading to Gallatin River from future build-out. Probable measurable change in water quality.		**(SI):** Change from recently documented trend degrading water quality to stabilized level. Limit amount phosphorus & nitrogen entering the river; prevent permanent, measurable degradation water quality. **(SI):** Stabilization of, or even improvement aquatic habitat.		**(SI):** Similar to those described under Proposed Action. Nondegradation standards for phosphorus and nitrogen remain numeric and narrative.	
Water quality – regulated sources		**(SI):** Increased nutrient loading in Gallatin. **(CI):** Cumulative impacts from regulated sources which contribute nutrients. Increases in sediment loading due to projected levels development on undeveloped and partially developed private land. Expansion residential development in Big Sky likely increase service connections to Big Sky County Water and Sewer District. This increase could lead to more nutrient loading in Gallatin River if District uses its MPDES flow-based discharge permit. Cumulative impacts regulated and nonregulated development lead to measurable increases in pollutant levels in Gallatin River.		**(SI):** Due to restriction nutrient loading from subsurface wastewater treatment systems, septic system drainfields outside footprint when development lies within footprint. This placement may concentrate drainfields adjacent to footprint boundary, potentially impacting other groundwater sources due spatial limits on drainfield locations. New development may be forced outside footprint. **(CI):** Cumulative impacts to water quality of Gallatin River would less than from No Action Alternative, since pollution from regulated sources of nutrients capped by "no measurable change" criteria.		**(SI):** Developers may seek approval sooner than later for drainfields within footprint to take advantage of waste load allocation. May encourage faster development within footprint until cumulative impacts analysis indicates trigger value met, then placement may concentrate drainfields adjacent to footprint boundary, potentially impacting other groundwater sources.	
Water quality – nonregulated sources	**(CI):** Sources wastewater discharge, not regulated by the federal, state or local agencies, not addressed. Cumulative degradation from these sources & permissible nonpoint sources may degrade water quality.	**(SI):** Unregulated development may lead measurable nutrient increases receiving streams; including landscape fertilizer runoff, livestock associated with recreation industry, release soil nutrients from timber clearing, increased storm water runoff, or general soil disturbance.					

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Cumulative Impacts		**(CI):** Cumulative impacts from multiple independently proposed developments not evaluated in regulatory framework.		**(SI):** Accounts for cumulative impacts subsurface wastewater treatment by limiting total nutrient loading under low flow conditions to below measurable change, i.e. trigger value for phosphorus.		**(SI):** Similar to Proposed Action.	
Mixing zones		**(SI):** If nondegradation limits nutrients not met in ground water prior to effluent reaching Gallatin River, mixing zone in river can be adopted. Result in localized reaches with elevated nutrient levels which may exceed trigger values until attenuation reduces levels below measurable change. Could allow permitting subsurface wastewater treatment systems which rely on mixing zone in Gallatin River for compliance.					
Water withdrawals	**(CI):** Water withdrawals expected increase with more individual wells drilled. Impact directly related to number SFEs using individual or community wells. (See Impacts described under Land Use and Socioeconomics for these numbers)						
Nutrient input		**(SI):** Increased transport nutrients to receiving waters (Gallatin River or tributaries). Increase nutrients could enhance algal and periphyton growth.		**(SI):** Decreased transport nutrients to receiving waters (Gallatin River or tributaries). Maintenance nutrient levels in ORW reach would limit proliferation periphyton and nuisance algae. **(CI):** Increase service connections to Big Sky County Water and Sewer District could cause more nutrient loading in Gallatin River if District uses its MPDES flow-based discharge permit.	**(SI):** Nutrient input could not increase with mitigation. Impacts same as under Proposed Action	**(SI):** Intermediate between those described under Proposed Action and No Action. Cumulative assessment should reduce overall nutrient input compared to No Action.	**(SI): N**utrient input could not increase with mitigation. Impacts same as under unmitigated Cumulative Impacts Analysis Alternative.

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Wastewater discharge and management		**(SI):** Increased nutrient loading soils result in nutrient saturation, primarily inorganic phosphorus. Increased mass soil containing or holding contaminants within footprint.		**(SI):** Reduced nutrient loading soils from subsurface wastewater treatment in footprint. Less nutrient loading soils due to limit of receiving stream (Gallatin River or tributaries) required have no measurable change water quality.	**(SI):** To meet ORW regulations nutrient input could not increase with mitigation. Therefore Impacts in this area would be the same as under the Proposed Action Alternative	**(SI):** Similar those under Proposed Action.	**(SI):** Nutrient input could not increase with mitigation. Impacts same as under unmitigated Cumulative Impacts Analysis Alternative.
Geology and Soils							
Ground disturbance	Disturbance would occur.	**(SI):** Increased erosion of disturbed soils could degrade water quality. **(CI):** Development footprint continues to full build-out.	**(CI):** Development and ground disturbance could occur same or greater density as unmitigated alternative.	**(CI):** Limits development could potentially limit total ground disturbance.	**(CI):** Development and ground disturbance could occur with same or greater density as unmitigated alternative.	**(CI):** Total acres disturbed for developed units probably between no-action and proposed action alternative.	**(CI):** Development and ground disturbance could occur with same or greater density as unmitigated alternative.
Erosion/sediment transport	**(CI):** Increased sediment loading due to projected levels development on undeveloped and partially developed private land.						
Developable terrain	Development in footprint would continue.	**(SI):** Greater likelihood disturbance wetlands & riparian habitat. **(CI):** Development footprint continues on suitable terrain. Development steep terrain likely.	**(CI):** Development in footprint same or greater density, within limits of zoning regulations, if alternative wastewater management facilities employed.	**(SI):** To prevent receiving streams from experiencing measurable water quality change, sources nutrient loads to groundwater hydrologically connected to streams within footprint limited. Within footprint some development could shift to less amenable terrain; steeper slopes or less stable soils. Could cause soil disturbance steeper areas with higher erosion potential.	**(CI):** Development in footprint with density equal to or greater than under No Action if alternative wastewater management employed.	**(CI):** Total numbers developed units probably between No Action and proposed action. Difficult to assess spatial arrangement on developable terrain.	**(CI):** Development in footprint with density equal to or greater than No Action could occur if alternative wastewater management facilities employed.
Wastewater management		**(PI):** Less stringent management. **(SI):** Increased nutrient loading to soils result in nutrient saturation, primarily inorganic phosphorus. Increased mass soil containing/holding contaminants within footprint. Increased transport nutrients to receiving waters.		**(SI):** Reduced nutrient loading to soils from subsurface wastewater treatment in footprint. Less nutrient loading soils due to limit of receiving waters required to have no measurable change water quality. Decreased transport nutrients to receiving waters.	**(SI):** Nutrient input could not increase with mitigation. Impacts same as under Proposed Action.	**(SI):** Similar to Proposed Action.	**(SI):** To meet cumulative assessment regulations, nutrient input could not increase with mitigation. Impacts same as under unmitigated Cumulative Impacts Analysis Alternative.

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Land Use and Recreation							
Land use - general		**(SI):** No impact on existing or planned land use within footprint or beyond ORW study area. Development would proceed according to plans/regulations agencies having land use jurisdiction within footprint.	**(SI):** Same as No Action without mitigation.	**(SI):** Restrict new development using conventional septic tank/leach fields in footprint. Development restrictions on private land equally applied to all undeveloped or partially developed land in footprint.	**(SI):** Development restrictions could be entirely mitigated by use alternative wastewater management systems. Use of such systems involves increased development cost. Feasibility primarily a function of economics of individual development proposals.	**(SI):** New development in footprint using conventional septic tank/leach field would likely b restricted, but t lesser extent than allowed by Proposed Action without mitigation, due to continued availability narrative standard & authorization to degrade options within existing regulations. Development restrictions (or potential) on private land not equally applied. Permitting of new development on a first come, first served basis. Applicants acting first, before cumulative pollutant trigger values reached able to develop using conventional septic tank/leach fields. Once cumulative trigger values reached, further applicants face increased costs or restrictions on allowable development.	**(SI):** Same as Proposed Action; development restrictions could be mitigated use alternative wastewater management. Development restrictions same as Cumulative Impacts Analysis Alternative without mitigation. First come, first served approach inherent; thus no mitigation possible.
Allowable development		**(SI):** Private Land: Current Gallatin County plans/ zoning regulations allow up to 652 additional dwelling units and estimated 419,000 sq. ft. additional commercial & community facilities built on currently undeveloped or partially developed lands in footprint. Forest Service Land: No plans for new facilities or expansions existing facilities in t footprint. State Land: Montana Fish, Wildlife and Parks may seek expansion Porcupine Creek complex near Big Sky; however no current plans to expand.	**(SI):** Same as No Action without Mitigation	**(SI):** A total of 75 additional dwelling units (DU) and approximately 2,645 sq. ft. additional commercial & community facilities allowed in footprint using conventional septic tank leach field wastewater management systems. This impact represents an 89% reduction in allowable additional dwelling units and an overall 99% reduction in allowable additional commercial or community facilities square footage.	**(SI):** Assuming use of alternative wastewater management, potential additional development in footprint same as described for No Action.	**(SI):** Not possible to quantify allowable development under this alternative due to narrative standard and authorization to degrade variables. Additional development in footprint would likely higher than estimates for Proposed Action without mitigation, due to availability these options. However, given State regulations & policy related to non-degradation, and the same degradation trigger values as under Proposed Action, unlikely that development approaching that expected under No Action would be permitted.	**(SI):** Assuming use of alternative wastewater management, potential additional development in footprint same as described for No Action.

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Recreation	**(PI):** No primary impacts on recreation.	**(SI):** No adverse primary impacts on recreation: Neither levels nor extent of development anticipated in footprint would impose new constraints on river access or capacity of river to accommodate recreation. **(SI):** Secondary water quality impacts due to increased development in footprint can have corresponding secondary impacts on recreation: Adverse fishery impacts (reduced fish size or carrying capacity in ORW reach) would adversely impact angler use and satisfaction; and adverse aesthetic impacts(as algal blooms) could reduce attractiveness of ORW reach. **(C1):** Water quality impacts from development in footprint could act cumulatively with similar impacts from development outside footprint (e.g., the larger Big Sky area), resulting corresponding cumulative secondary impacts to recreation.	**(SI, CI)**: Avoidance of or reduction in secondary or cumulative recreation impacts dependent on mitigation measures applied for secondary water quality impacts. If water quality mitigation successful, corresponding recreation impacts reduced.	**(SI):** Reduction in pollutant loads in river, compared with No Action; long-term positive effect on recreation by protecting river attributes important to recreation users. Quality of recreational experience, as influenced by water quality, protected.	**(SI):** Same as Proposed Action without mitigation.	**(SI):** Same as Proposed Action without mitigation.	**(SI):** Same as Proposed Action without mitigation.
Rafting/boating	**(SI):** Commercial rafting days & private shoreline & river-boating use days expected to continue & may increase slightly. **(CI):** Might be slight increase commercial rafting & recreational tourism.			**(SI):** Probably same as No Action.		**(SI):** Probably same as No Action.	
Angler use		**(SI):** If trout population declines, recreational fishery could seer reduction in angler use. Potentially fewer anglers make ORW destination for fishing trips. Impacts to popular caddis, mayfly & stonefly hatches could affect recreational fishery. Anglers may fish alternative rivers (Yellowstone & Madison) if seasonal hatches		**(SI):** Anglers continue come to Gallatin to fish “blue ribbon” fishery. Angler use may increase in t short term if publicity of ORW designation entices them to the river.		**(SI):** Angler satisfaction likely remains high.	

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		on Gallatin noticeably reduced. Relocation angler activity would reduce associated tourism dollars.					
Angler satisfaction		**(SI):** Adverse impacts to the fishery (i.e. reduced trout growth and carrying capacity, therefore reduced size and numbers of fish) would reduce angler satisfaction.		**(SI):** Angler satisfaction likely remains high or increase with cachet ORW status.		**(SI):** Angler satisfaction likely remains high.	
Socioeconomics							
Angler benefits and economic value		**(SI):** Slight reduction from current $3.84 million value.		**(SI):** Maintain existing $3.84 million dollar value.	**(SI):** Maintain existing $3.84 million dollar value.	**(SI):** Maintain existing $3.84 million dollar value.	**(SI):** Maintain existing $3.84 million dollar value.
Rafting/boating and “other” recreation economic value	**(SI):** Maintenance of existing $6 million net economic value of recreation benefits.	**(SI):** Net economic value to boaters expected to continue or increase slightly. **(SI):** Current trends of increased economic activity associated with recreation expected to continue. However, decrease in water quality associated with No Action could involve potentially adverse effects to existing angler use & spending, but may be offset by positive effects associated with build-out of residential & vacation units. **(CI):** Maintains current local economies of Big Sky & West Yellowstone. Most significant economic loss likely small reduction in net economic value fishing to anglers from reduced trout catch or trout size.		**(SI):** Maintain current quantity & quality recreation uses along ORW. Current annual net economic value fishing & other river-related recreation maintained. ORW designation could be interpreted as signal of quality, & attract additional anglers, further increasing economic value of fishing above current level. Net economic value for non-angling, noncommercial recreation days on river continue. **(CI):** Existing angler and other river recreation use levels, river tourism jobs and income would be maintained.	**(SI):** Maintain current quantity & quality recreation uses along ORW. Current annual net economic value fishing & other river- related recreation maintained. ORW designation could be interpreted as signal of quality, & attract additional anglers, further increasing economic value of fishing above current level. Net economic value for non-angling, noncommercial recreation days on river continue.	**(SI):** Maintain current quantity & quality recreation uses along ORW. Current annual net economic value fishing & other river- related recreation maintained. Net economic value for non-angling, noncommercial recreation days on river continue.	**(SI):** Maintain current quantity & quality recreation uses along ORW to extent that narrative exclusions not granted by DEQ or that advanced wastewater treatment required in footprint. Existing angler & other river recreation use levels maintained
Tourism related jobs and expenditures		**(SI):** Unknown small losses or small gains to existing 438 jobs & $7.3 million annual out-of-state visitor expenditures.		**(SI):** Maintain existing 438 jobs & $7.3 million annual out-of-state visitor expenditures.	**(SI):** Maintain existing 438 jobs and $7.3 million in annual out-of-state visitor expenditures.	**(SI):** Maintain existing 438 jobs & $7.3 million annual out-of-state visitor expenditures.	**(SI):** Maintain existing 438 jobs & $7.3 million annual out-of-state visitor expenditures.
Recreation employment		**(SI):** Employment with commercial rafting companies continues, & may increase slightly.		**(CI):** Existing net economic values associated with fishing & rafting continue, tourism -related income & employment continue.		**(SI):** Same as Proposed Action.	

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Construction related employment		**(SI):** Maintain existing 274 jobs in study area.		**(SI):** If standard subsurface wastewater treatment used in new residential & commercial construction in footprint, reduced build-out would result in eventual loss up to 90 jobs in study area and associated $6.86 million per year worker income loss.	**(SI):** Maintain between 184 & 274 jobs in study area depending on how advanced water treatment is in new homes within footprint. May not result in any job loss if full build-out occurs in footprint by using alternative wastewater treatment.	**(SI):** Eventual loss up to 90 jobs in study area and associated $6.86 million per year worker income loss unless narrative standards approvals are granted or advanced treatment systems used.	**(SI):** Maintain between 184 & 274 jobs in study area depending on how advanced water treatment is in new homes in the footprint & number of narrative standards approvals granted by DEQ. May not result in any job loss if full build-out occurs in footprint by using alternative wastewater treatment.
Other employment sectors		**(SI):** Current level economic activity will maintain current levels direct employment in real estate sector. Associated increase in residents & rental visitors result in small increase income & employment in retail & food services sectors once build-out complete.		**(SI):** Multiplier effects from reduced build-out limitations result in loss up to 30 jobs in real estate, transportation, and local government. **(CI):** Build-out limitations imposed by maintenance existing water quality would eventually reduce direct employment in construction sectors, and multiplier effects would result in slight reductions in real estate & transportation.	**(SI):** Using advanced wastewater treatment, much of e entire build-out associated with No Action could occur. Maintains jobs in real estate, retail and food services. **(CI):** Advanced treatment systems would increase build-out potential in footprint & maintain current levels employment in real estate. Slight increase employment in property management & waste management services with construction & maintenance more effective treatment systems. May not result in job loss if full build-out occurs in footprint by diverting wastewater disposal to outside the footprint.	**(SI):** Multiplier effects from reduced construction up to 30 less jobs real estate, transportation, local government unless narrative standards approvals granted or advanced treatment used.	**(SI):** Maintain jobs real estate, retail & food services depending on advanced water treatment in new homes in footprint and number of narrative standards approvals granted by DEQ. May not result in job loss if full build-out occurs in footprint by diverting wastewater disposal to outside footprint.
Property value		**(SI):** Reduction in water quality & aesthetics associated with algae will result in slight decline property values or slow down in rise in property values near ORW. **(SI):** 652 more housing units should moderate rise in house/condo price increases, & degree of unaffordability of housing compared to household median income in West Yellowstone & Big Sky.		**(SI):** Protect existing property value differential associated with water quality. Limitations on build-out increase new dwelling units, & increase prices for existing & new units. Housing affordability slightly worse than No Action **(CI):** Housing affordability further reduced if demand for housing increases & build-out limited.	**(SI):** Maintain current value or slightly increase rise of values. Housing affordability slightly worse than No Action.	**(SI):** Maintain current value or slightly decrease values due to uncertainty regarding permanence. Housing affordability slightly worse than No Action.	**(SI):** Maintain current value or slightly decrease values in area due to uncertainty regarding permanence. Housing affordability slightly than No Action.

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Allowable new homes & commercial space in footprint		**(SI):** 652 dwelling units & 419,000 sq. ft. commercial space.		**(SI):** 67 dwelling units (89% reduction from No Action) and 2,645 sq. ft. commercial space (99% reduction from No action).	**(SI):** Between 67 & 652 new dwelling units & between 2,645 & 419,000 sq. ft. commercial space depending on how advanced water treatment for new homes/commercial businesses in footprint.	**(SI):** 67 dwelling units (89% reduction from No Action) and 2,645 sq. ft. of commercial space (99% reduction from No Action).	**(SI):** Between 67 & 652 new dwelling units & between 2,645 & 419,000 sq. ft. commercial space depending on advanced water treatment for new homes/commercial businesses in footprint or # narrative standards approvals granted by DEQ.
Change in housing costs associated with use of advance wastewater systems		**(SI):** % Change per unit: None $ Change per unit: None Total dollar cost: None	**(SI):** % Change per unit: + 1% to 8% $ Change per unit: $3,200 to $20,000 Total dollar cost: $1.8 to $11.5 million	**(SI):** % Change per unit: None $ Change per unit: None Total dollar cost: None	**(SI):** % Change per unit: + 1% to 8% $ Change per unit: $3,200 to $20,000 Total dollar cost: $1.8 to $11.5 million	**(SI):** % Change per unit: + 1% to 8% $ Change per unit: $3,200 to $20,000 Total dollar cost: $1.8 to $11.5 million	**(SI):** % Change per unit: Less than + 1% to 8% depending on number of narrative standards approvals granted by DEQ. $ Change per unit: $3,200 to $20,000 Total dollar cost: $1.8 to $11.5 million
Passive use/Existence values to Montana households		**(SI):** Slight loss passive use values of MT residents expected with maintaining current water quality.		**(SI):** Passive use values (option, existence & bequest values from water quality) to MT residents associated with current water quality would be maintained.	**(SI):** Passive use values (option, existence & bequest values from water quality) to MT residents associated with current water quality would be maintained.	**(SI):** Passive use values (option, existence and bequest values from water quality) to Montana residents associated with the current water quality would be maintained.	**(SI):** Passive use values (option, existence & bequest values from water quality) to MT residents associated with current water quality would be maintained.
Aquatic Life and Habitats							
TMDL Program	**(CI):** TMDL programs may reduce nutrient loading. Participation & cooperation with TMDLs voluntary for nonpoint sources (septic systems); no way to quantitatively assess potential nutrient load improvements.						
Water quality – phosphorus and nitrogen loading		**(SI):** Increased phosphorus & nitrogen loading. **(CI):** Potential reduction in flow due to increased well development would diminish overall dilution of nutrients after entering Gallatin River.	**(SI):** Any reductions nutrient levels benefit aquatic community compared to unmitigated No Action Alternative.	**(SI):** Cap on phosphorus & nitrogen loading.	**(CI):** Potential reduction flow due to increased well development would diminish overall dilution nutrients after entering Gallatin River.	**(SI):** Limit on phosphorus & nitrogen loading to trigger values as assessed against existing & permitted nutrient inputs.	**(SI):** Total nutrient loading allowed same as the unmitigated Cumulative Impacts Analysis.

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Dissolved oxygen and nitrite levels		**(SI):** Potential reduction in dissolved oxygen due to increased algae. Increased nitrogen levels on trout fry expected to reduce trout numbers or size. **(CI):** Reduction in available oxygen and increased nitrites.	**(SI):** Any reductions nutrient levels would benefit aquatic community compared to unmitigated No Action.	**(SI):** Controlled nutrient levels contribute to maintaining existing dissolved oxygen and nitrite levels.		**(SI):** Similar to Proposed Action.	
Macroinvertebrate community		**(SI):** Shift in composition macroinvertebrate community toward towards more nutrient tolerant community species with less energetic value to trout.. Midges continue to be plentiful, but large hatches of caddis, mayflies, and stoneflies may be reduced.	**(SI):** Any reductions nutrient levels benefit aquatic community compared to unmitigated No Action.	**(SI):** Should remain same as current macroinvertebrate community.		**(SI):** Similar to Proposed Action.	
Periphyton and algae		**(SI):** As nutrient levels increase increased algae. Possible adverse aesthetic impacts (e.g. algal blooms) downstream of ORW reach (within ORW reach, cold water temperatures tend to minimize such impacts from increased nutrient levels).	**(SI):** Any reductions in nutrient levels benefit aquatic community compared to unmitigated No Action.	**(SI):** Algal communities remain same as current with no additional nutrients.		**(SI):** Algal communities remain same as current with no additional nutrients.	
Fisheries							
Effects to rare, threatened, and endangered species	**(SI):** No aquatic T&E species in study area. Montana species of concern only incidentally encountered in proposed ORW reach, and its not critical habitat for any Montana species of concern. Impacts to these species not significant.						

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Effects to fish habitat		**(SI):** Gradual decline water quality would negatively impact fish community & its habitat. **(CI):** Cumulative impacts to Gallatin River's fishery exacerbated by shifts in periphyton & macroinvertebrate communities. Possible decreased surface water supply due to residential water use inside footprint. Any reduction in total surface flow would reduce available habitat for fish, & diminish overall dilution of nutrients entering Gallatin River.	**(CI):** If mitigation reduces overall nutrient input, impacts to fisheries habitat reduced.	**(SI):** Maintenance existing nutrient levels allow persistence high-quality aquatic habitat. **(CI):** Reductions total future numbers septic systems & residential wells help maintain existing groundwater supplies.	**(CI):** If mitigation allows increased build-out near or in riparian zone, potential negative impacts to fisheries habitat.	**(SI):** Minor impacts due to slight increase in nutrient levels.	**(CI):** If mitigation allows increased build-out near or in riparian zone, potential negative impacts to fisheries habitat.
Fish community - eggs/fry	**(CI):** Unregulated nonpoint sediment sources continue to pose potential threat to incubating eggs & fry.	**(SI):** Increased nitrogen levels expected to reduce trout numbers or trout size. If nitrate levels reach 2.0 mg/L, likely to adversely affect rainbow trout fry and eggs.	**(SI):** Any reductions in nutrient levels benefit fish community compared to unmitigated No Action.	**(SI):** Trout reproduction & recruitment likely to continue at current levels.	**(CI):** If mitigation allows increased build-out near riparian zone, possible negative impacts to trout reproduction & recruitment.	**(SI):** Trout reproduction & recruitment likely continue at current levels. Increase nutrient levels not likely significantly different from the Proposed Action.	**(CI):** Impacts likely similar to mitigated Proposed Action.
Fish community - adult		**(SI):** Added stress from increased nitrates; adverse effects on adult growth, reproduction, and survival of fish. If trout carrying capacity decreases, total trout population likely to decrease, or experience reduced growth, increased competition, increased susceptibility to disease, or reduced reproduction success.	**(SI):** Reductions in nutrient levels benefit fish community compared to unmitigated No Action Alternative.	**(SI):** Persistence of existing species diversity & preservation of Gallatin River habitat for salmonids.	**(CI):** If mitigation allows increased build-out near riparian zone, possible negative impacts to trout reproduction & recruitment.	**(SI):** Impacts likely similar to Proposed Action.	**(CI):** If mitigation allows increased build-out near riparian zone, possible negative impacts to trout reproduction & recruitment.
Macroinvertebrate community shift		**(SI):** Shift composition trout food base may reduce trout numbers or trout size. Changes in aquatic macroinvertebrate community (food base for trout) potentially reduce growth and total carrying capacity of ORW reach. If food quantity or quality decreases, number trout that grow & thrive decreases.	**(SI):** Any reductions in nutrient levels would benefit fish community compared to unmitigated No Action.	**(SI):** Current macroinvertebrate community likely persists & provide consistent food base for trout.		**(SI):** Impacts likely similar to Proposed Action.	
Terrestrial Vegetation and Habitats							

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Development		**(SI):** Increased ground disturbance from retained pace & extent development. **(SI):** Ground disturbance for development of permanent structures result in permanent loss of vegetation. Vegetative disturbances may be short-term if rough graded & soft graded areas revegetated with native species. Removal of existing weed biomass & seed source may be beneficial impact. **(CI):** Removal vegetation within riparian zone may cause cumulative impacts on water catchment, infiltration, & delivery from rain. These changes in soil water content & water availability negatively affect vegetation but may benefit some noxious weeds.		**(SI):** Decreased ground disturbance due to reduction extent of development. **(SI):** Reduction in build out result in less permanent loss of vegetation. Vegetative disturbances may be short-term if rough graded & soft graded areas revegetated with native species. **(CI):** Cumulative impacts same as No Action alternative, but to lesser extent.	**(SI):** Increased ground disturbance from retained pace & extent development. **(SI):** Ground disturbance for development permanent structures would result in permanent loss of vegetation. Vegetative disturbances may be short-term if rough graded & soft graded areas revegetated with native species. Removal existing weed biomass and seed source may be beneficial impact. **(CI):** Removal vegetation within riparian zone may cause cumulative impacts on water catchment, infiltration, & delivery from rain. These changes in soil water content & water availability negatively affect vegetation but may benefit some noxious weeds.	**(SI):** Decreased ground disturbance due to reduction in extent of development. **(SI):** Reduction build out result in less permanent loss of vegetation. Vegetative disturbances may be short-term if rough graded &soft graded areas revegetated with native species. **(CI):** Cumulative impacts same as No Action, but to lesser extent.	**(SI):** Increased ground disturbance from retained pace & extent development. **(SI):** Ground disturbance for development of permanent structures result in permanent loss of vegetation. Vegetative disturbances may be short-term if rough graded & soft graded areas revegetated with native species. Removal existing weed biomass & seed source may be beneficial impact. **(CI):** Removal vegetation within riparian zone may cause cumulative impacts on water catchment, infiltration, & delivery from rain. These changes in soil water content & water availability negatively affect vegetation but may benefit some noxious weeds.
Native plant communities		**(SI):** Native plant communities may be permanently altered or replaced with nonnative species, creating fragmented native habitat. Revegetated areas require time for vegetation to reestablish. **(CI):** Fragmentation could impact overall plant productivity and wildlife use. Fragmentation can impact size and proximity of habitat patches, increase amount of habitat edge, ultimately impacting quality of habitat for birds and mammals.		**(SI):** Native plant communities may be permanently altered or replaced with non-native species, creating fragmented native habitat. Revegetated areas require time for vegetation to reestablish. Impacts reduced if less development occurs. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Native plant communities may be permanently altered or replaced with nonnative species, creating fragmented native habitat. Revegetated areas require time for vegetation to reestablish. **(CI):** Fragmentation could impact overall plant productivity and wildlife use. Fragmentation can impact size and proximity of habitat patches, increase amount of habitat edge, ultimately impacting quality of habitat for birds and mammals.	**(SI):** Native plant communities may be permanently altered or replaced with non-native species, creating fragmented native habitat. Revegetated areas require time for vegetation to reestablish. Impacts reduced if less development occurs. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Native plant communities may be permanently altered or replaced with nonnative species, creating fragmented native habitat. Revegetated areas require time for vegetation to reestablish. **(CI):** Fragmentation could impact overall plant productivity and wildlife use. Fragmentation can impact size and proximity of habitat patches, increase amount of habitat edge, ultimately

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							impacting quality of habitat for birds and mammals.
Effects to rare, threatened, and endangered species		**(PI):** Potential removal of slender Indian paintbrush plants. **(SI):** Impacts from noxious weeds on species of concern include potential increased competition, displacement, & plant damage or mortality resulting from herbicide drift during weed management. **(CI): I**mpacts on species of concern vary. Potential impacts caused by development & other ground disturbances could affect species ability to persist, & vulnerabilities to extinction in Montana.		**(SI):** Could limit number of future dwelling units and commercial properties. Impacts to plants of concern are less likely. **(CI):** Same as No Action, but to lesser extent.	**(PI):** Potential removal of slender Indian paintbrush plants. **(SI):** Impacts from noxious weeds on species of concern include potential increased competition, displacement, & plant damage or mortality resulting from herbicide drift during weed management. **(CI): I**mpacts on species of concern vary. Potential impacts caused by development & other ground disturbances could affect species ability to persist, & vulnerabilities to extinction in Montana.	**(SI):** Could limit number of future dwelling units and commercial properties. Impacts to plants of concern are less likely. **(CI):** Same as No Action, but to lesser extent.	**(PI):** Potential removal of slender Indian paintbrush plants. **(SI):** Impacts from noxious weeds on species of concern include potential increased competition, displacement, & plant damage or mortality resulting from herbicide drift during weed management. **(CI): I**mpacts on species of concern vary. Potential impacts caused by development & other ground disturbances could affect species ability to persist, & vulnerabilities to extinction in Montana.
Slender Indian paintbrush		**(PI):** Potential removal slender Indian paintbrush plants. **(SI):** This species vulnerable to hydrologic alterations if water table lowered by increased number of wells. Will incur greatest impacts from future development since occurs on private lands that are partially developed. Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Any loss in abundance or habitat for slender Indian paintbrush probably not affect ability to persist in Gallatin County.		**(SI):** Vulnerability to hydrologic alterations reduced due to fewer SFEs & thus fewer wells. Direct impacts to slender Indian paintbrush less likely. Because occurrences next to existing roads & trails, degree of secondary impacts same as under No Action. Habitat could experience impacts from noxious weed spread. **(CI):** Impacts on slender Indian paintbrush would not affect ability to persist in Gallatin County.	**(PI):** Potential removal slender Indian paintbrush plants. **(SI):** This species vulnerable to hydrologic alterations if water table lowered by increased number of wells. Will incur greatest impacts from future development since occurs on private lands that are partially developed. Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Any loss in abundance or habitat for slender Indian paintbrush probably not affect ability to persist in Gallatin County.	**(SI):** Vulnerability to hydrologic alterations reduced due to fewer SFEs & thus fewer wells. Direct impacts to slender Indian paintbrush less likely. Because occurrences next to existing roads & trails, degree of secondary impacts same as under No Action. Habitat could experience impacts from noxious weed spread. **(CI):** Impacts on slender Indian paintbrush would not affect ability to persist in Gallatin County.	**((PI):** Potential removal slender Indian paintbrush plants. **(SI):** This species vulnerable to hydrologic alterations if water table lowered by increased number of wells. Will incur greatest impacts from future development since occurs on private lands that are partially developed. Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Any loss in abundance or habitat for slender Indian paintbrush probably not affect ability to persist in Gallatin County.

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Hall's rush		**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Ability persist in Gallatin County may be reduced. Overall viability in Montana &global range not impacted.		**(SI):** Habitat could experience impacts from noxious weed spread. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Ability persist in Gallatin County may be reduced. Overall viability in Montana &global range not impacted.	**(SI):** Habitat could experience impacts from noxious weed spread. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Ability persist in Gallatin County may be reduced. Overall viability in Montana &global range not impacted.
Large-leafed balsamroot		**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Ability persist in Gallatin County may be reduced. Overall viability in Montana &global range not impacted.		**(SI):** Habitat could experience impacts from noxious weed spread. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Ability persist in Gallatin County may be reduced. Overall viability in Montana &global range not impacted.	**(SI):** Habitat could experience impacts from noxious weed spread. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Ability persist in Gallatin County may be reduced. Overall viability in Montana &global range not impacted.
Discoid goldenweed		**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Potential impacts caused by development & other ground disturbances could increase vulnerability to extinction in Montana, but not global viability.		**(SI):** Habitat could experience impacts from noxious weed spread. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Potential impacts caused by development & other ground disturbances could increase vulnerability to extinction in Montana, but not global viability.	**(SI):** Habitat could experience impacts from noxious weed spread. **(CI):** Same as No Action, but to lesser extent.	**(SI):** Distribution & abundance could suffer from increased invasion noxious weeds. **(CI):** Potential impacts caused by development & other ground disturbances could increase vulnerability to extinction in Montana, but not global viability.
Noxious weeds		**(SI):** Future development has potential to increase area & density of infestations. Soil brought in for development may provide better habitat for weeds than native soil. If development spreads weed seed to new areas, weeds become a problem on additional public & private lands. Conversely, removal existing weed biomass & seed source may be beneficial. **(CI):** Cumulative impacts of noxious weed spread may include declines in native plant community diversity, increased sedimentation, & decreased wildlife or livestock forage.		**(SI):** Reduced development result in less ground disturbance (assuming no mitigation), thus secondary impacts of noxious weed spread lower. **(CI):** Cumulative impacts noxious weed spread may include declines native plant community diversity, increased sedimentation, & decreased wildlife or livestock forage.	**(SI):** Future development has potential to increase area & density of infestations. Soil brought in for development may provide better habitat for weeds than native soil. If development spreads weed seed to new areas, weeds become a problem on additional public & private lands. Conversely, removal existing weed biomass & seed source may be beneficial. **(CI):** Cumulative impacts of noxious weed spread may include declines in native plant community diversity, increased sedimentation, & decreased wildlife or livestock forage.	**(SI):** Reduced development result in less ground disturbance (assuming no mitigation), thus secondary impacts of noxious weed spread lower. **(CI):** Cumulative impacts noxious weed spread may include declines native plant community diversity, increased sedimentation, & decreased wildlife or livestock forage.	**(SI):** Future development has potential to increase area & density of infestations. Soil brought in for development may provide better habitat for weeds than native soil. If development spreads weed seed to new areas, weeds become a problem on additional public & private lands. Conversely, removal existing weed biomass & seed source may be beneficial. **(CI):** Cumulative impacts of noxious weed spread may include declines in native

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							plant community diversity, increased sedimentation, & decreased wildlife or livestock forage.
Wildlife							
Wildlife - general	**(PI):** No primary impacts to wildlife.	**(SI):** If eutrophication reduces fish or invertebrate productivity or changes species composition, fish-eating (river otter, bald eagle, osprey or mergansers) or insect-eating (shrews, swallows or warblers) wildlife may be affected by change in prey base. **(CI):** Habitat losses from increased development combined with other habitat losses & increased encroachment on wildlife habitat may cumulatively affect wildlife by reducing long-term population viability. Species less compatible with humans (grizzly bear) or those requiring larger areas contiguous habitat; more likely affected.	**(SI):** Using alternative water treatment so no negative effects on aquatic ecology; would be no impacts to wildlife from reduced water quality. **(CI):** Zoning, planning development with wildlife habitat as focus, and implementing & enforcing food & garbage storage policies could reduce impacts to wildlife from increased development.	**(SI):** Secondary impacts to wildlife may be beneficial. Proposed Action represents the potential for an overall 89% reduction in allowable dwelling units & 99% reduction in commercial square footage (less habitat loss), as well as long term protection of water quality. **(CI):** Any impacts beneficial relative to No Action.	**(SI):** Mitigation would make build-out potential nearly identical to No Action. Increase in build-out nullifies the benefits to wildlife due to reduced land use in footprint.	**(SI):** Impacts to wildlife likely intermediate between Proposed Action & No Action. Magnitude of impact depends on use of narrative standard, approval of application to degrade. If surge in development occurs early on, & DEQ's continued adherence to Cumulative Impacts Analysis. **(CI):** Likely similar to Proposed Action & beneficial compared to No Action.	**(SI):** Impacts with mitigation would be intermediate to impacts with mitigation from the No Action & Proposed Action alternatives.
Habitat		**(SI):** Increased development could cause habitat loss, habitat fragmentation, & increased disturbance by humans. Fragmentation plant communities detrimental to plant productivity & therefore wildlife use. Higher density development translates to more disturbances to wildlife, through traffic, domestic pets, & general human activity.		**(SI):** Less loss of habitat with less development, beneficial for wildlife.		**(SI):** Impacts to wildlife likely intermediate between Proposed Action & No Action. Magnitude of impact depends on use of narrative standard, approval of application to degrade. If less loss of habitat with less development, beneficial for wildlife.	
Effects to rare, threatened, and endangered species		**(SI):** Bald eagles could be negatively affected if No Action Alternative results in degraded water quality & reduction in		**(SI):** Would not adversely affect federally listed wildlife species, & may have beneficial effects. If Proposed Action results in lower		**(SI):** Would not adversely affect federally listed wildlife species, & may have beneficial effects. If Cumulative Impacts Analysis	

Table 2-3. Condensed description of potential impacts related to the three alternatives considered in detail in the Gallatin River Outstanding Resource Water Designation Draft Environmental Impact Statement.

Potential Impact **(PI) = Primary** **(SI) = Secondary** **(CI) = Cumulative**	**Common to All Action Alternatives**	**Alternative 1: No Action**	**Alternative 1: No Action with Mitigation Measures**	**Alternative 2: Proposed Action**	**Alternative 2: Proposed Action with Mitigation Measures**	**Alternative 3: Cumulative Impacts Analysis**	**Alternative 3: Cumulative Impacts Analysis with Mitigation Measures**
		prey base. Grizzly bears could be affected by increased human development & use in bear habitat. Effects to wolves or lynx not likely significant or measurable.		dwelling unit density, loss of habitat & human disturbance less than under the No Action. Preservation water quality beneficial to bald eagles & indirectly to other species.		results in lower dwelling unit density, loss of habitat & human disturbance less than under the No Action. Preservation water quality beneficial to bald eagles & indirectly to other species.	
Air Quality							
	(SI): Some gradual decrease in air quality as level of development in Gallatin Canyon increases.			**(SI):** May limit development, & therefore less air pollution from fewer future construction activities.	**(SI):** If mitigations implemented virtually no difference in development potential & subsequent impacts to air quality compared to No Action.		
Cultural Resources							
	(PI): No primary impacts to cultural resources likely. **(CI):** Possibly cumulative impacts to cultural resources.	**(SI):** Impacts cultural resources within study area due to ground disturbance during site development. Entire study area has not been surveyed; therefore, total number & distribution sites currently not known. However, given existing documentation, reasonable to assume some disturbance of cultural sites.		**(SI):** With less development, less ground disturbance and lowered impacts to cultural resources.	**(SI):** If mitigations adopted, Proposed Action will present secondary impacts virtually identical to those under No Action.	**(SI):** If less development, less ground disturbance and lowered impacts to cultural resources.	
Aesthetics							
Visual resources	**(PI):** None. **(CI):** No effects to visual character or appearance of surrounding viewsheds or topography.	**(SI):** Aesthetic impacts from increased development primarily noticeable in commercial & residentially zoned areas. Density of development may impact aesthetic quality of the corridor near highway. **(CI):** Development could continue to full build-out; could impair aesthetic quality of river corridor near highway.		**(SI):** Substantially reduced level from No Action. Reduction in density of development would protect aesthetic quality of river corridor. **(CI):** Future development could impair aesthetic quality of river corridor near highway, but reduced from No Action.	**(SI):** Impacts same as No Action. **(CI):** Development to full build-out, which could impair aesthetic quality of river corridor near highway.	**(SI):** Substantially reduced level from No Action. Reduction in density of development would protect aesthetic quality of river corridor. **(CI):** Future development could impair aesthetic quality of river corridor near highway, but reduced than No Action.	**(SI):** Impacts same as No Action. **(CI):** Development to full build-out, which could impair aesthetic quality of river corridor near highway.

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Chapter 3 Affected Environment

3.1 Introduction

Chapter 3 describes components of the existing environment that could be affected by the Proposed Action or alternatives to the Proposed Action. The Proposed Action is described in detail in Section 2.3 of Chapter 2.

Chapter 3 serves three purposes: (1) it provides a baseline from which to analyze and compare alternatives and their impacts; (2) it ensures that the Board has a clear understanding of the environment potentially affected by the Proposed Action; and (3) it provides the public information to evaluate the agency's alternatives, including the Proposed Action. The environmental components described in this chapter include air, water, geology, soils, vegetation, fish and wildlife, cultural, aesthetics, land use, and socioeconomics. In general, the affected environment is defined by the extent to which the implementation of the proposed ORW designation would affect each resource. The study areas are discussed in the Inventory Methods sections for each resource component, since they vary in location and extent by component.

3.2 Geology and Soils

3.2.1 Overview

3.2.1.1 Regional Geology

The Madison Range, west of the upper Gallatin River, consists of basement rocks covered by folded Paleozoic (543 to 248 million years ago [mya]) and Mesozoic (248 to 65 mya) sedimentary formations, with active faults along the western and southern edges. Basement rocks are the oldest rocks in an area, and are often metamorphic or igneous in origin; their name refers to their relative position in age and location among the geologic layers. To the east side of the Gallatin River lies the Gallatin Range. The range is very similar to the Madison Range, but the basement rocks are less evident (Alt and Hyndman 1986).

3.2.1.2 Soils

Soils in the study area exhibit varying permeability, depending on location and source of the geologic parent material. Soils with greater permeability, such as sand, allow water to move through them more quickly. Greater permeability occurs in the higher elevation areas, while moderate to low permeability soils are generally noted in the lower elevations. Soils along the upper Gallatin River are typically included in the Intermountain and Piedmont section of soils. They can be further subdivided as soils associated with forested mountains, low terrace fans, and flood plains associated with forested mountains (USDA SCS 1982)

Erodibility and subsequent sediment loading to streams from the study area soils are based on soil type and location. Areas of high potential sediment delivery are located in the northern portion of the study area. Lower sediment delivery potentials are located in the central and southern portions, with the exception of Taylor Fork and Cache Creek.

3.2.2 Inventory Methods

The study area for soils and geology was defined as the Upper Gallatin, which consists of approximately 530,800 acres within the Gallatin River sub-basin.

Readily available documents referencing the geology and soils for the study area were reviewed to include basic geologic and soils maps, soil surveys, and special studies of the hydrology, water quality, and aquifer vulnerability. These include two hydrogeologic evaluations performed by Baldwin in 1996 and 1997, and historical studies performed by Montagne in 1976 and Van Voast in 1972. General geology and soils information was provided by Alt and Hyndman (1986), Fenneman (1931), Montagne (1976), USDA SCS (1982), and EPA (2005). Maps from the Soil Conservation Service (USDA SCS 1978), geologic maps (Kellogg and Williams 2000, O’Neil and Christiansen 2002), and current total maximum daily load (TMDL) documents (EPA 2005) were evaluated.

Various agencies, researchers, and publicly-owned treatment works were contacted to assess any ongoing studies of the study area. Personal communications with Mel White and Peter McCarthy of USGS, Art Compton and Eric Regensburger of DEQ, William Woessner of University of Montana, Stephan Custer from Montana State University, and Ron Edwards of the Big Sky Water and Sewer District were also made in early 2006.

3.2.3 Inventory Results

3.2.3.1 Geology

The upper Gallatin River area is in the southeastern portion of the Rocky Mountain Physiographic Province, according to Fenneman’s (1931) classification noted in Montagne (1976). The upper Gallatin River area includes both the Madison and Gallatin ranges, with numerous peaks over 10,000 feet and elevations ranging from 5,000 to 11,200 feet above mean sea level (MSL) (EPA 2005).

The Gallatin River flows across a large area of regional uplift and crosses three major and many minor faults within the study area. The geology controls much of the character of the Gallatin River basin, including the topography, locations of canyons and valleys, sources of ground water, and land use.

The rocks seen at the surface are largely controlled by three major faults: Cherry Creek Fault to the north, Spanish Peaks Fault near Big Sky, and Buck Creek Fault on the south end of the study area. The Cherry Creek Fault crosses the river near its confluence with Spanish Creek. The most conspicuous of the major faults, the Spanish Peaks Fault crosses the river about one-half mile below the confluence with the West Fork of the Gallatin River, forming the prominent Levinski Ridge. Large springs flow to the Gallatin River from Madison Group limestone at the contact with this fault. The Buck Creek Fault crosses the Gallatin River near Cinnamon Creek. Snowflake Springs occurs where an offshoot from this fault, called the Snowflake Thrust, crosses the Gallatin River (Kellogg and Williams 2000). All three faults generally run northwest to southeast.

The oldest rocks in the Madison-Gallatin structural block are the Archean-age (3800 to 2500 mya) metamorphic rocks dominated by distinctive layers of gneiss. For more information on rocks in the study area, see Alt and Hyndman (1986). In most of the region from the confluence with the West Fork of the Gallatin River north to Spanish Creek, the river has cut a narrow canyon through ancient Precambrian (4,500 to 543 mya) rock. In the Castle Mountain area, a several-mile-long wedge of younger sedimentary rock offers less resistance to erosion and results in a wider valley. These are the rocks forming the steep-sided canyon, which contains much of the Gallatin River between its confluences with the West Fork of the Gallatin River and Spanish Creek. Since these rocks are highly resistant to erosion, the river has created little or no alluvial valley in this reach.

Between Yellowstone National Park and the West Fork of the Gallatin River, the basement rocks are overlain by a sequence of upper Paleozoic-age carbonate and clastic sedimentary rocks and Mesozoic clastic rocks, which are dominantly Cretaceous in age. Metamorphic and sedimentary rocks of the Madison-Gallatin blocks were uplifted, faulted, and folded during the Laramide deformation, and then eroded prior to deposition of Eocene-age (54.8 to 33.7 mya) volcanic rocks (Baldwin 1996). The Laramide time period began 70 million years ago and lasted 30 million years, during which mountain-building deformation occurred in the Eastern Rocky Mountains. The Gallatin River has carved an alluvial valley in these softer rocks, which varies from several hundred feet to one-half mile in width. These portions of the Gallatin River Valley are filled with sand, gravel, and boulders that form the highly permeable alluvial aquifer.

3.2.3.2 Soils

Soils in the upper Gallatin River Valley are associated with forested mountains, low terrace fans, and flood plains. Soils in these areas can be characterized as undulating to rolling soils in valleys on foothill glacial moraines; moderately sloping to very steep soils on mountains; areas of rock outcrops; steep and very steep soils on mountains; moderately sloping to steep soils on foothills; and soils on low terraces, fans and flood plains (USDA SCS 1978, USDA SCS 1982).

General soil permeabilities in the study area range from moderately slow (0.2 to 0.6 in/hr) to moderately rapid (2.0 to 6.0 in/hr) with a majority of soils characterized by a moderate permeability (0.6 to 2.0 in/hr). Areas around the Taylor Fork and West Fork of the Gallatin River have moderately slow permeabilities, while areas at higher elevations above the West Fork of the Gallatin River, Taylor Fork, and Storm Castle Creek basins exhibit moderately rapid permeabilities (EPA 2005).

Based on soil erosion potential and distance to receiving waters, the northern portions of the study area, downstream of the West Fork confluence of the Gallatin River, show higher rates of soil loss to the creeks when compared to the central and southern portions. According to sediment delivery maps for the current TMDL assessment, which show where erosion impacts waterbodies, areas of potentially high sediment delivery occur in the Storm Castle and Swan Creek regions, upper Spanish Creek, Hell Roaring Creek, and Cache Creek and upper Taylor Fork region (EPA 2005).

3.3 Hydrology and Water Quality

3.3.1 Overview

The major hydrologic feature of the study area consists of the Upper Gallatin River mainstem and its tributaries. The headwaters of the Gallatin River are in Yellowstone National Park in southwestern Montana and northwestern Wyoming. The study area for the ORW reach includes approximately 43.6 miles of the Gallatin mainstem and six watersheds (5^{th} code HUCs) from the Yellowstone National Park boundary to the south, downstream to the confluence with Spanish Creek to the north. The river is fed in the ORW reach by nine primary tributaries: Sage Creek, Taylor Fork, Buck Creek, Porcupine Creek, West Fork of the Gallatin River, Swan Creek, Storm Castle Creek, Hell Roaring Creek, and Spanish Creek (EPA 2005). The Gallatin River converges with the Jefferson and Madison rivers near Three Forks, Montana, to form the Missouri River.

Sources of water to the Gallatin River consist of surface water run-off from precipitation and snowmelt and discharge from groundwater aquifers along the valley. Base flow to the river is derived from groundwater from the alluvial aquifer adjoining the river and from large springs (Snowflake Springs and others near the West Fork confluence) believed to originate from the Madison Group limestone aquifer (S. Custer, pers. comm. 2006).

Historic development in the Big Sky area has affected water quality via increased nutrient (such as nitrates and phosphates) loading, primarily from wastewater discharges and construction activities. Surface water monitoring in the Big Sky area from 1994 to 1996 showed no nutrient or metal parameter concentration above existing maximum contaminant levels (MCLs) allowed. However, in later years, in streams in the Big Sky area nutrient levels for nitrogen and phosphorous have shown an increase that exceeds target nutrient levels for similar streams in western Montana (Baldwin 1997). Also, algal growth indicates nutrient input from the West Fork is having a detrimental impact on the Gallatin mainstem [See Section 3.6.3].

3.3.2 Inventory Methods

For water quality analyses, the study area was defined as the upper Gallatin River mainstem to the USGS gauging station below the Spanish Creek confluence near Gallatin Gateway, Montana, and its tributaries.

3.3.2.1 Surface Water

There have been several hydrologic studies within the study area, but they typically are associated with specific projects or concerns relating to the surface water and groundwater hydrology of the Big Sky area. As a consequence, the studies have focused on the West Fork of the Gallatin River. These include two hydrogeologic evaluations performed by Baldwin in 1996 and 1997, a historical study performed by Van Voast in 1972, and an evaluation of hydraulic conductivity along the Gallatin mainstem performed by Morrison-Maierle (1997). Maps from current TMDL documents (EPA 2005) were also evaluated.

Readily available documentation of the surface water in the study area was reviewed from current TMDL documents (EPA 2005) and USGS stream information (McCarthy 2005), water quality data collected by the Blue Water Task Force (K. Alvin, pers. comm. 2006), and a limited site reconnaissance. State and federal agencies, universities, and publicly-owned treatment works were contacted to acquire recent and ongoing studies of the study area. These include personal communications in 2006 with Mel White and Peter McCarthy of USGS, Art Compton and Eric Regensburger of DEQ, William Woessner of University of Montana, Stephan Custer from Montana State University, Katie Alvin of the Blue Water Task Force, and Ron Edwards of the Big Sky Water and Sewer District.

Characterization of surface water flow and quality has been performed using the Upper Gallatin Total Maximum Daily Load (TMDL) Planning Area Phase I Planning Report dated April 2005 (EPA 2005), and primary data and statistical stream information collected and published by the U.S. Geological Survey (McCarthy 2005).

3.3.2.2 Groundwater

Groundwater in the study area was characterized using regional geologic maps. Specific studies of groundwater conducted in the Big Sky area were used to assess aquifer vulnerability to contamination. Other studies were used to assess nondegradation standards for proposed subdivisions. In addition, the Ground Water Information Center (GWIC) database was used to obtain information on well locations and density, aquifer lithology, and depth to the water level in wells. GWIC is an internet-based searchable database of private water wells in the state (http://mbmggwic.mtech.edu/ accessed February 2006).

Regional geologic mapping (Kellogg and Williams 2000) provided information on the underlying geology, which allowed identification of known aquifers in the study area. The Baldwin (1996) study of groundwater and aquifer vulnerability in the Big Sky area provided the best watershed-scale assessment of the occurrence of groundwater and of the interaction between groundwater and surface water. The nondegradation studies for subdivision permitting provided site-specific, detailed pictures of the hydrogeology at points of interest along the Gallatin River. These studies also disclose important aquifer parameters, such as hydraulic conductivity and gradient. These parameters were used to calculate the velocity of groundwater movement and to help define the zone of direct hydrologic connection between groundwater and the Gallatin River.

3.3.3 Inventory Results

3.3.3.1 Surface Water

The study area is characterized by a continental climate, which has cold and snowy winters and warm, dry summers. Records for the study area indicate annual precipitation levels of 40 to 60 inches in the higher areas, 28 to 40 inches at medium elevations, and 16 to 28 inches at the lower elevations (EPA 2005). Measured annual precipitation at Gallatin Gateway and Big Sky is 22.6 and 19.9 inches, respectively (WRCC 2006). The heaviest months of precipitation are May and June, with most significant snowfall from November through March (EPA 2005).

Snow accumulation is measured at Carrot Basin (9,000 feet MSL) located near the headwaters of Sage Creek in the southwest corner of the study area, and Lone Mountain (8,800 feet MSL) located in the upper West Fork of the Gallatin River drainage near Big Sky (USDA NRCS 2005). Average snow water equivalent appears to peak in April and May at both locations. Carrot Basin has higher snow water values, approximately 30 inches, compared to Lone Mountain's values of approximately 20 inches. The difference may be attributed to higher annual precipitation in the Carrot Basin area (EPA 2005).

There is one active USGS gauging station at the downstream end of the study area. USGS gauging stations measure water quality parameters such as flow and temperature. The station (06043500: Gallatin River near Gallatin Gateway) is located 0.3 mile downstream from the confluence with Spanish Creek, approximately 7.3 miles south of Gallatin Gateway, at river mile 47.7 with an elevation of 5,167.67 feet (National Geodetic Vertical Datum 1929).

Sixty-seven years of flow records for the mainstem of the Gallatin River measured at this gauging station indicate an annual maximum mean flow of 1,180 cubic feet per second (cfs), a minimum annual mean of 408 cfs, and an annual mean of 802 cfs. Flow data indicated a 7-day consecutive 10-year low flow of 204 cfs for this reach (McCarthy 2005). This flow is referred to as the "7Q10" for the watershed within the proposed ORW reach. Low flow occurs during winter months, with the lowest flow in January. Peak flow occurs in the summer months, with the maximum flow in June.

Two types of streams feed the upper Gallatin River study area: perennial (streams that flow year round), and intermittent/ephemeral (streams that flow for a short period, usually in spring, or are discontinuous in flow). Perennial streams comprise 848 of the 919 total tributary miles, while intermittent/ephemeral streams encompass the remaining 71 miles. Intermittent/ephemeral streams are primarily located in the upstream, southern portion of the watershed, and the upper portions of Spanish Creek near the north end of the proposed ORW reach (EPA 2005).

There are several surface water impoundments, both natural and man-made, in the proposed ORW designation area. These are located in Big Sky and provide for storm water control, aesthetic value, and lawn irrigation. There is limited agricultural irrigation in the study area as indicated by the agricultural land use summary in the TMDL study, with only 160 acres, or 0.2%, of non-federal agricultural land use (EPA 2005).

Water quality parameters of concern from domestic sewage are primarily nitrogen and phosphorus. These constituents undergo transformation from one compound to another during degradation in the environment. Nitrogen compounds from domestic waste are primarily in the form of urea, which is then converted to ammonia, nitrate, and nitrite as the wastewater moves through the wastewater treatment system and is disposed to the ground. Conversion of nitrate to nitrogen gas can also occur in the wastewater treatment system and in the soils beneath the ground surface. Phosphorus is discharged primarily in the form of orthophosphate; its migration in the subsurface environment is controlled primarily through soil sorption and mineralization.

The USGS water quality database for the gauging station at Gallatin Gateway contains 171 water quality records between June 24, 1949, and August 23, 2004. The mean levels of nitrate/nitrite,

ammonia, and orthophosphate were 0.08 milligrams per liter (mg/l), <0.02 mg/l, and <0.01 mg/l, respectively (USGS 2006a). Elevated levels of ammonia, nitrite, nitrate, and phosphorus may cause violation of ARM 17.30.637(1)(e), which prohibits creating a condition that produces undesirable levels of aquatic life, such as algal blooms.

Baldwin (1997) performed water quality sampling in 1994 and 1996 as part of an aquifer vulnerability assessment of the Big Sky area. Results of sampling in the West Fork of the Gallatin River in June 1995 through July 1996 indicated levels of nitrate were lowest in mid-summer (<0.01 mg/l as N) and highest in January (0.28 mg/l as N). Orthophosphate levels ranged from 0.003 to 0.064 mg/l for the same sampling period. Higher levels in winter are due to the combination of lower streamflow available for dilution and higher resort occupation levels during the winter ski season. Results indicated that no nutrient parameters were above numeric human health water quality standards, although nutrient levels of nitrogen and phosphorus were above recommended target levels for aquatic and aesthetic protection for similar streams in western Montana (Baldwin 1997).

The Blue Water Task Force, a local volunteer organization, collected water quality samples within the proposed ORW reach May 2000 through February 2004 (BWTF 2006). Samples were collected monthly at up to seven locations along the mainstem of the Gallatin River, and selected tributary sites including the West Fork of the Gallatin River. Volunteers trained by the Blue Water Task Force conducted all sampling using premeasured water quality kits and sample preservation vials for samples that needed to be processed at a lab for analytes such as coliform bacteria. Water quality data collected included pH, nitrates, Coliform bacteria, water and air temperature, dissolved oxygen, and turbidity. No sample results exceeded any regulatory standard (BWTF 2006, K. Alvin, pers. comm. 2006).

According to TMDL documentation prepared by the EPA in 2005, there currently are four MPDES discharge permits on the upper Gallatin River. Three permits are located near Big Sky, Montana, near the confluence of the West Fork of the Gallatin River and the mainstem of Gallatin River. They consist of two storm water applications (mining/oil operations and industrial) and one municipal treatment plant. The municipal MPDES permit was issued to the Big Sky Sewer District (EPA 2005.) One storm water discharge is located in an upper unnamed tributary south of Hell Roaring Creek.

The Big Sky Water and Sewer District MPDES permit (MT-0030384) allows discharge from March through June with a discharge rate varying monthly from 150 to 525 gallons per minute (0.216 million gallons per day (Mgpd) to 0.756 Mgpd). The permit requires water quality monitoring, including nutrients, upstream and downstream of the discharge as well as at the discharge outfall.

The permit discharge limits were calculated to meet the criteria for nonsignificance which is the trigger values of 0.01 mg/l nitrate as N and 0.001 mg/l phosphorus as P. The permit was effective April 1, 1999 and has been administratively extended beyond its expiration date of September 30, 2003 in order to complete the renewal of the permit. According to Ron Edwards of the Big Sky Water and Sewer District, there has been no discharge to the Gallatin River (R. Edwards, pers. comm. 2006).

Recent TMDL assessments have classified several designated uses as threatened in six tributaries. Areas of concern were Storm Castle Creek, Taylor Fork, Cache Creek, Middle Fork and South Fork of the West Fork, and West Fork of the Gallatin River. Listed impairments to these streams are as follows (EPA 2005):

- The 1996 303(d) list reported that the coldwater fishery designated uses in Storm Castle Creek were threatened due to flow alteration, other habitat alterations, and siltation. The 2004 303(d) list showed Storm Castle Creek as only partially supporting aquatic life and coldwater fish due to bank erosion, fish habitat degradation, other habitat alterations, and nutrients.
- Taylor Fork was not listed as impaired on the 1996 303(d) list, but did appear on the 2004 303(d) list. In 2004, Taylor Fork was listed as only partially supporting aquatic life, coldwater fishery, and industry due to siltation, fish habitat degradation, suspended solids, and other habitat alterations.
- Cache Creek was listed as impaired on the 1996 303(d) list due to siltation, which was impairing aquatic life and coldwater fish. In 2004, Cache Creek was listed as only partially supporting aquatic life and coldwater fishery due to siltation, other habitat alteration, and suspended solids.
- The Middle Fork of the West Fork of the Gallatin River was on the 1996 303(d) list as only partially supporting aquatic life and coldwater fishery due to siltation and suspended solids. In 2004, an additional designated use – recreation - was added as being only partially supported on the Middle Fork of the West Fork of the Gallatin River. Several causes of impairment were shown: nutrients, bank erosion, pathogens, suspended solids, and other habitat alterations.
- The 1996 303(d) list indicated that the South Fork of the West Fork of the Gallatin River only partially supported aquatic life and coldwater fishery due to siltation and suspended solids. The South Fork was on the 2004 303(d) list as partially supportive of aquatic life, coldwater fishery, and recreation. The causes of impairment listed in 2004 were nutrients, bank erosion, pathogens, suspended solids, and other habitat alterations.
- The West Fork of the Gallatin River was listed on the 1996 303(d) list as only partially supporting aquatic life and coldwater fishery. The causes of impairment were listed as siltation and suspended solids. Recreation was added as a partially supported designated use on the 2004 303(d) list, and the following causes were cited: nutrients, siltation, and algal growth (as indicated by chlorophyll *a* measurements).

3.3.3.2 Groundwater

Groundwater in the study area is available in two primary types of aquifers: bedrock and unconsolidated deposits. Groundwater in bedrock aquifers may be confined by rocks with relatively low permeability (flow-through rate) and have little or no connection to streams, or it may be unconfined and potentially in direct hydrologic connection with streams. Unconsolidated deposits in the study area typically have water that is unconfined and hydrologically connected to the Gallatin River and its tributaries. The river valleys of the Gallatin River and the principal tributaries generally contain alluvial aquifers that are in hydrologic connection with the streams (except in areas of steep canyons).

The principal bedrock aquifers in the area surrounding Big Sky, based on local use and regional significance (from oldest to youngest in age), include the Madison Group, Quadrant Sandstone, the Morrison Formation, the Kootenai Formation, Thermopolis Shale, Muddy Sandstone, Mowry Shale, Frontier Formation, and Cody Formation (Baldwin 1996). Although some bedrock units possess little intrinsic permeability, all bedrock units in the Big Sky area are potential aquifers due to extensive fracturing (Baldwin 1997). Most bedrock aquifers in this area provide water yields of 1 to 30 gallons per minute (gpm) (Baldwin 1997). The Madison aquifer is a karstified limestone (meaning it contains large voids and interconnected solution channels), which is capable of extremely high yields of water to springs and wells. Snowflake Springs, near the southern end of the study area, is an example of a high yield spring from Madison karst. High water yields are possible in any bedrock aquifer along major geologic faults and structures, as these faults and structures provide secondary flow pathways.

The chemical character of groundwater in bedrock aquifers is variable and depends on the local rock type and the aquifer geochemistry. Calcium, magnesium, or sodium may dominate the cations (positively charged ions), and bicarbonate, sulfate, or a mixture of these two ions may dominate the anions (negatively charged ions). The concentration of total dissolved solids (TDS) is usually in the range of 300 to 500 mg/l, but has exceeded 1,000 mg/l in the Mowry Shale of the Big Sky area (Baldwin 1997). The groundwater of the Big Sky area is suitable for domestic, stock, and irrigation use (Van Voast 1972).

The unconsolidated aquifers consist of up to 80 feet of boulders, gravel, sand, and clay deposits overlying bedrock units. These aquifers consist of stream-laid alluvium or terrace deposits, which are typically hydrologically connected to adjoining streams. Some terrace deposits may be unsaturated, but sources of recharge, including wastewater, are free to migrate to the alluvial aquifer, which is in connection with the river (Morrison-Maierle 1997). The unconsolidated aquifers yield as much as 200 gpm to municipal wells of the Big Sky Water and Sewer District, and yields of 40 gpm are common (Baldwin 1996). Therefore, materials introduced into groundwater in these aquifers can travel quickly to the closest surface water.

The chemical characterization of the groundwater in the unconsolidated aquifer is typically a calcium/magnesium/bicarbonate type, with a TDS content of 300 to 400 mg/l (Baldwin 1997). It is suitable for domestic, stock, and irrigation use (Van Voast 1972).

Baldwin (1997) found that, of 21 domestic well and five public water well samples in the Big Sky area, nutrient concentrations (nitrogen and phosphorus) in groundwater were always below the maximum contaminant level of 10 mg/l. The highest nitrate (NO_3-N) concentration was 3.86 mg/l, and was believed to be affected by septic system effluent. Total phosphorus concentrations ranged from less than the detection limit to 0.212 mg/l.

3.4 Land Use and Recreation

3.4.1 Overview

This section reviews the land uses in the Gallatin River area with a focus on how land use is regulated, who uses it, and how those uses have changed in recent years. The regulatory nature of the Proposed Action drives this focus. In order to evaluate how land use may be impacted by the Proposed Action and the alternatives, it is critical to understand how land use is currently regulated and how the various agencies review and decide upon proposed changes in land use such as subdivisions. This document presents regulations that are relevant to the environmental impact assessment; therefore, it is not an exhaustive review of all zoning or permitting currently in force. Readers are encouraged to visit the Gallatin County and DEQ websites for complete regulatory texts.

3.4.1.1 Land Use

Most of the land surrounding and immediately along the proposed ORW reach of the Gallatin River is in public ownership. This public land is primarily federal, managed by the Gallatin National Forest. Some state lands are present, most of which are part of the Gallatin Wildlife Management Area managed by Montana Fish, Wildlife and Parks. Little development or disturbance from activities such as logging, mining, or road development has occurred on these public lands, and no substantial projects are planned in the foreseeable future. Areas where logging has occurred in the recent past are being restored. Current and projected management activities are oriented to protecting and improving water quality, conserving and enhancing wildlife habitat and other natural resource values, and providing for outdoor recreation activities.

Private lands in the ORW study area are concentrated largely in the Big Sky area, along the Gallatin River and the West Fork of the Gallatin and their tributaries. Smaller concentrations of private ownership occur along the Gallatin River and U.S. Highway 191 at and immediately south of the Spanish Creek confluence, in the Karst area, and south of Big Sky.

Gallatin County has jurisdiction on all private land in the study area. County plans and regulations governing land use and development divide the ORW study area into three distinct parts: the Gallatin Canyon/Big Sky Zoning District, the South Gallatin Zoning District, and the un-zoned area between Spanish Creek and the northern boundary of the Gallatin Canyon/Big Sky Zoning District. In each of these areas, conditions differ in terms of designated land use classifications, allowable development densities, and response to water quality concerns (e.g., setback requirements) attendant to development near rivers and streams.

Existing and planned uses along the ORW reach are predominantly low density residential, with a relatively large concentration of commercial, light industrial, and community facilities uses in Big Sky, and scattered instances of commercial uses elsewhere along U.S. Highway 191. A third to a half of the private land in the study area is currently undeveloped or capable of more intensive development based on underlying zoning, and the Gallatin Canyon/Big Sky Zoning District is one of the fastest growing areas in the County.

3.4.1.2 Recreation

The primary recreation uses on the Gallatin River in the ORW study area are fishing (the Gallatin is a Blue Ribbon fishery) and commercial and recreational rafting and kayaking. Other popular activities include: wildlife-based recreation (wildlife viewing and hunting), hiking, picnicking, camping, nature photography, and environmental education. The latest annual estimates of recreation use in the study area are: 31,485 angler days in 2003 (FWP 2005; reported for the Gallatin River from Spanish Creek to the headwaters); 20,000 commercial rafting days in 1997 (Forrest 1997); and over 13,000 user days combining the remaining activities noted above in 1990 (derived from Duffield et al. 1990). Recreational use is increasing in the ORW study area, with visitors citing scenery, quality fishing, low levels of crowding and user conflicts, accessibility, and services as the primary positive factors that make the area attractive.

3.4.2 Inventory Methods

The study area for land use and recreation covers a broad area to provide relevant context information for the proposed ORW designation and alternatives. On the east and west, as shown on Figure 3.4-1, the area is defined by a combination of the Gallatin County Line and the watershed boundary of the Gallatin River ORW reach. The study area is framed by Spanish Creek on the north and Yellowstone National Park on the south. Within this study area, land use and recreation information is presented from two perspectives:

1. Areawide, broad-scale land use and management activities are reviewed for their potential to have long-term implications for water quality on the proposed ORW reach. This review focuses primarily on the federal and state lands that comprise the vast majority of the study area, and includes such activities as logging, mining, and general water quality management/protection programs. As a rule, the proposed ORW designation would not directly affect these activities. However, they are relevant to understanding long-term trends and prospects for water quality maintenance.

2. More detailed information is provided on land use and recreation immediately along the proposed ORW reach and tributary streams (i.e., lands within the ORW footprint). It is these lands that may be directly affected by the ORW designation. Thus, specific information is needed on land use and level of existing and potential development.

Land use and recreation information has been derived exclusively from existing published sources, interviews with knowledgeable agency personnel, and limited field reconnaissance.

3.4.3 Inventory Results

3.4.3.1 Current Land Ownership

Land ownership patterns in the area surrounding and immediately along the proposed ORW reach of the Gallatin River are shown in Figure 3.4-1.

Most land in the study area is in public ownership, under federal jurisdiction within the Gallatin National Forest. Most of the state lands are present immediately east of Big Sky (roughly 1,600 acres), in the southeastern part of the area, and in the Taylor Fork drainage.

Private lands are concentrated largely in and around Big Sky, west of the proposed ORW reach, along the West Fork of the Gallatin River, and along its tributaries. Smaller concentrations of private land are present: 1) along the Gallatin River at and to the south of the Spanish Creek confluence; 2) on the Gallatin River in the Karst Ranch area; and 3) south of Big Sky along the Gallatin River and Taylor Fork.

3.4.3.2 Land Use Plans and Development Regulations

Federal Land

The most recent comprehensive management plan for the Gallatin National Forest was completed in 1987 (USDA Forest Service 1987). In order to reflect changing conditions and management directions over the past 19 years, the Forest Service intends to revise the 1987 plan in the near future. Because the 1987 plan is currently under revision, the following discussions of plans and policies in the Forest are based on: 1) discussions with responsible Gallatin National Forest personnel; and 2) planning documents addressing specific issues or elements of management that eventually will be incorporated into a new Forest Plan (i.e., travel and access management, timber harvest management, water quality, etc.).

Aspects of forest land use, management planning, and policy most relevant to the proposed ORW designation are those that could have implications for water quality in the ORW reach of the Gallatin River, specifically: overall water quality management direction, land exchanges, fuels management, logging/timber sales, mining activity, recreation residences, recreation sites/facilities, grazing/range management, and roads/access management. Each of these is discussed below.

Overall Water Quality Management

A primary objective in management of National Forest System lands in the study area is protection and improvement of water quality (M. Story, pers. comm. 2006). Of particular importance is control of erosion and consequent sedimentation of water courses. The Forest Service's ongoing and planned management actions in the ORW study area aim for either no net long-term increase or further incremental reductions in sedimentation rate (M. Story, pers. comm. 2006). These actions include stringent Best Management Practices (BMPs) for all potential ground-disturbing activities such as fuels management or timber harvest, and reductions in use pressure associated with access roads and grazing (M. Story, pers. comm. 2006).

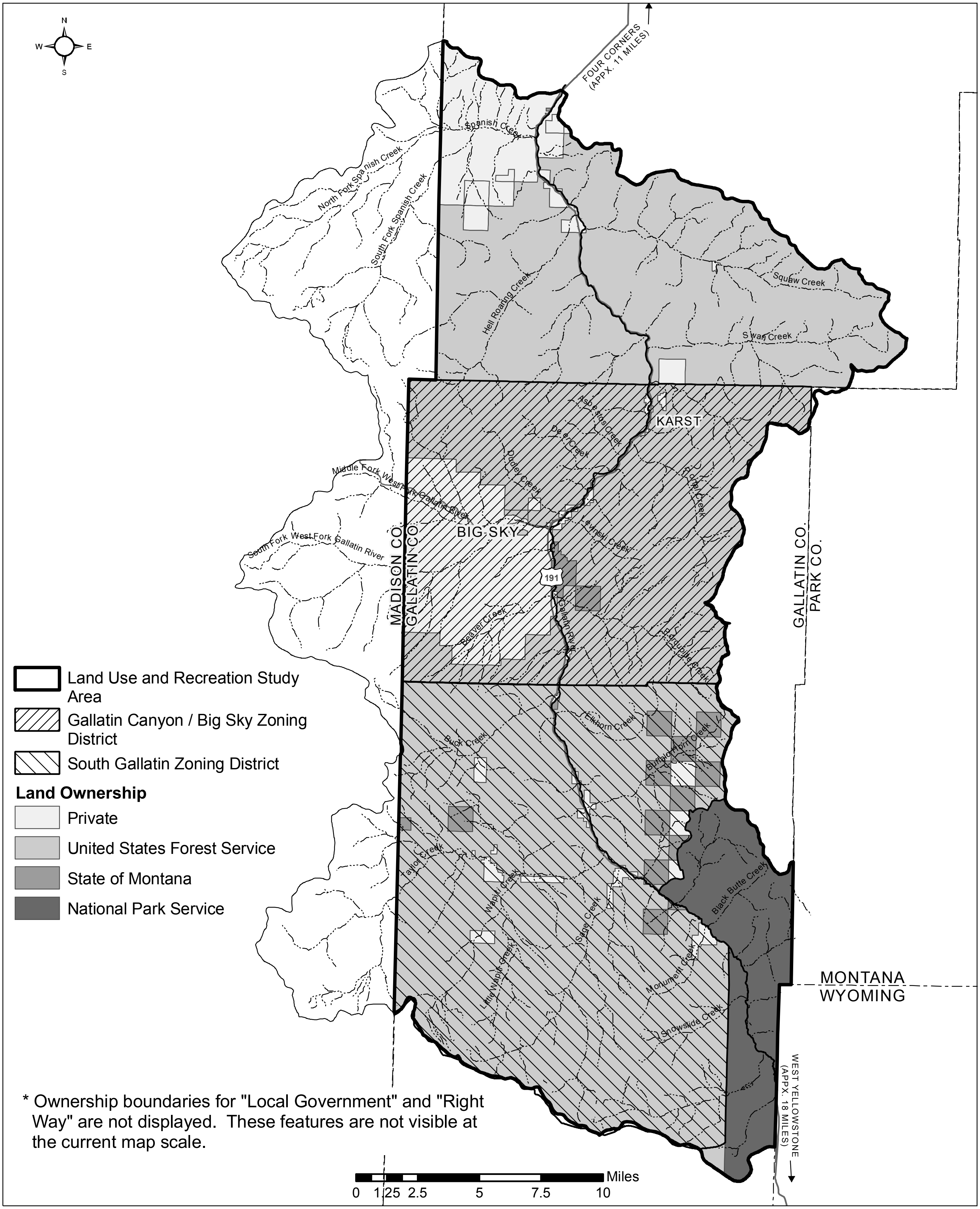

FIGURE 3-4-1

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LAND OWNERSHIP AND JURISDICTION
GALLATIN RIVER ORW EIS

Land Exchanges

No significant federal land sales or exchanges are currently planned in the ORW study area: however, one prior exchange is still relevant to actions and management programs in the Gallatin National Forest surrounding the proposed ORW reach. Commonly known as the Big Sky Lumber Exchange, the Gallatin Land Consolidation Act of 1998 (U.S. Senate Act 1719) authorized an exchange with Big Sky Lumber Company. The Forest Service acquired approximately 54,000 acres of Big Sky Lumber Company land, including substantial acreage in the Taylor Fork area. In exchange, Big Sky Lumber Company acquired approximately 31,000 acres of federal land (much outside of the ORW study area) and other compensation. This exchange resulted in a significant net increase in federal ownership, and a consolidation of private ownership in the ORW study area. The net effect was that few significant private in-holdings remain in the Gallatin National Forest surrounding the proposed ORW reach, and most private ownership is now concentrated in the Big Sky area.

Fuels Management

Fuel management projects ongoing or planned in the ORW study area are summarized below. Generally, these projects involve controlled burns, commercial thinning, understory thinning, and/or slash management. In all cases, no long-term water quality impacts that would create a measurable change in water quality are anticipated (Seth 2006).

- The Gallatin Canyon North Fuels project will be implemented over a five-year period. It involves two large (approximately 700-acre) and one small (20-acre) burn, and 17 acres of commercial thinning. The burns are near Deer and Dudley creeks, while the harvest is near Jack Smith Bridge on U.S. Highway 191.
- The Dudley Corridor Evacuation Route Project is a 40-acre project proposed to slash fuels along the Dudley Creek road to improve the evacuation route. No heavy machinery will be used, and material will be hand piled and burned.
- The Taylor Fork Fuels project proposes 30 acres of commercial thinning around the Nine Quarter Circle Ranch, 85 acres of commercial thinning in the Sage Creek drainage, and 350 acres of understory thinning.
- Ongoing slash treatment efforts include 40 acres of pile burning in the Taylor Fork drainage, two burns totaling approximately 22 acres in the Moose Creek drainage, and two burns totaling approximately 18 acres in the Swan Creek drainage.

Logging/Timber Sales

No significant timber sales or other major logging activity is planned in the ORW study area. Small 0.5 to 1 acre “post and pole” and firewood sales occur on an on-going basis. Two moderate-sized timber sales and subsequent harvest have recently been closed (completed): the 200-acre Taylor Fork-Helio sale in the Taylor Fork drainage, roughly 10 miles west of the confluence with the Gallatin River, and the 400-acre Moose-Swan Tamphery-Portal sale east of the Karst area (S. Martell, pers. comm. 2006). Both of these were part of the Big Sky Lumber Company land exchange process, which collected timber sale receipts from several sales to purchase part of the lands conveyed to the Gallatin National Forest. The Taylor Fork-Helio sale was designed as a “no sediment” action (i.e., BMPs were designed to ensure no net sediment

increase in the Taylor Fork; M. Story, pers. comm. 2006). Monitoring of BMP implementation for the Moose-Swan Tamphery-Portal sale is ongoing. The 2005 monitoring review found that most of the soil and water BMPs met requirements with adequate protection of soil and water resources, and that sedimentation impacts to Moose and Tamphery creeks were very minor (Jones et al. 2005).

Mining

There are no existing or planned mining operations in the ORW study area. There are three active mining claims in the area (based on 2002 records - the latest currently available; general locations shown in Figure 3.4-2), but no proposals for developing these claims have been submitted or are anticipated. Past mining activity is evident in the study area, including the asbestos and mica mines shown in Figure 3.4-2 and many small operations. However, all mines are abandoned and none are sources of discharge to the Gallatin River or its tributaries (P. Werner, pers. comm. 2006).

Recreation Residences

Eighty-one “Special Use Permit” recreation residences are located on Forest-managed lands along the ORW reach of the Gallatin River or nearby along tributary streams. Figure 3.4-2 depicts the general location of these residences. No new recreation residences, or expansions or alterations to existing ones, are anticipated. Any proposed changes to these residences that could affect water quality (e.g., replacement of vault toilet with septic tank and leach field) would require approval by county and state authorities, and would be subject to environmental review by the Forest Service under NEPA (J. Ruchman, pers. comm. 2006).

Recreation Sites/Facilities

No new recreation sites or expansions or alterations to existing ones are currently planned on Gallatin National Forest land in the ORW study area (J. Ruchman, pers. comm. 2006). Figure 3.4-2 shows the locations of existing recreation sites, including campgrounds, picnic/day-use sites, and trailheads. Campground and picnic area facilities are summarized in Table 3.4-1. Trailheads generally include a small parking area. Some have vault toilets.

Table 3.4-1. Forest Service Recreation Sites on the ORW Reach, West Fork of the Gallatin River, and Taylor Fork.

Site	Campsites-Individual	Campsites-Group	Picnic Sites	Toilet Facilities[a]
Greek Creek	14	-	-	Yes
Swan Creek	13	-	-	Yes
Moose Creek Flat	12	1	3	Yes
Red Cliff	13	2	4	Yes

[a] Primarily vault toilets
Source: USDA Forest Service 2005a.

The absence of current plans for expansion of existing recreation sites does not preclude a future determination of need or desirability to pursue some level of capacity expansion. While it is unlikely that new sites would be proposed, some capacity expansion at existing sites may be needed over time (T. Keyes, pers. comm. 2006). Any such future expansions or alterations to these sites that could affect water quality would require approval by county and state authorities,

and would be subject o environmental review by the Forest Service under NEPA (J. Ruchman, pers. comm. 2006).

Grazing and Range Management

Grazing pressure is being reduced in the watershed of the ORW reach. No new allotments are being issued and existing allotments that cause water quality concern are being modified or eliminated. Some permittees are not renewing their allotments due to more stringent management requirements (M. Story, pers. comm. 2006).

Roads/Access Management

There are no significant proposals for new roads in the ORW study area, and much of the watershed is un-roaded**.** The Gallatin National Forest has released the Draft EIS for its revised Travel Management Plan (USDA Forest Service 2005b). At present, the favored alternative for this Plan would result in a net reduction in road mileage and restoration of vegetation in prior road corridors. A number of road corridors are being restored in the Swan Creek, Storm Castle Creek, and Taylor Fork watersheds, where formerly private lands were acquired in the above-referenced Big Sky Lumber Company land exchange and where road density is relatively high (S. Christiansen, pers. comm. 2006)

State Land

Almost all of the state lands in the ORW study area are part of the Gallatin Wildlife Management Area (WMA), managed by Montana Fish, Wildlife and Parks. These lands are managed to support a wide variety of wildlife and, outside of seasonal closures, are open to hunting, fishing, and other wildlife-oriented recreation. Management is closely coordinated with that of the Forest Service on surrounding federal lands. There are no developed day use or overnight recreation sites. The approximately 1,660 acres located along Porcupine Creek immediately east of Big Sky have the only developed facilities. These facilities support general WMA management, research, and educational activities, and include two cabins, a barn, and storage shed. There are no current plans for expansion of the Porcupine Creek facilities or for new facilities elsewhere on state lands in the ORW study area (F. King, pers. comm. 2006). However, interest in use of the Porcupine Creek facilities for research and educational activities is increasing and some expansion of capacity at this location may be desirable in the future (F. King, pers. comm. 2006).

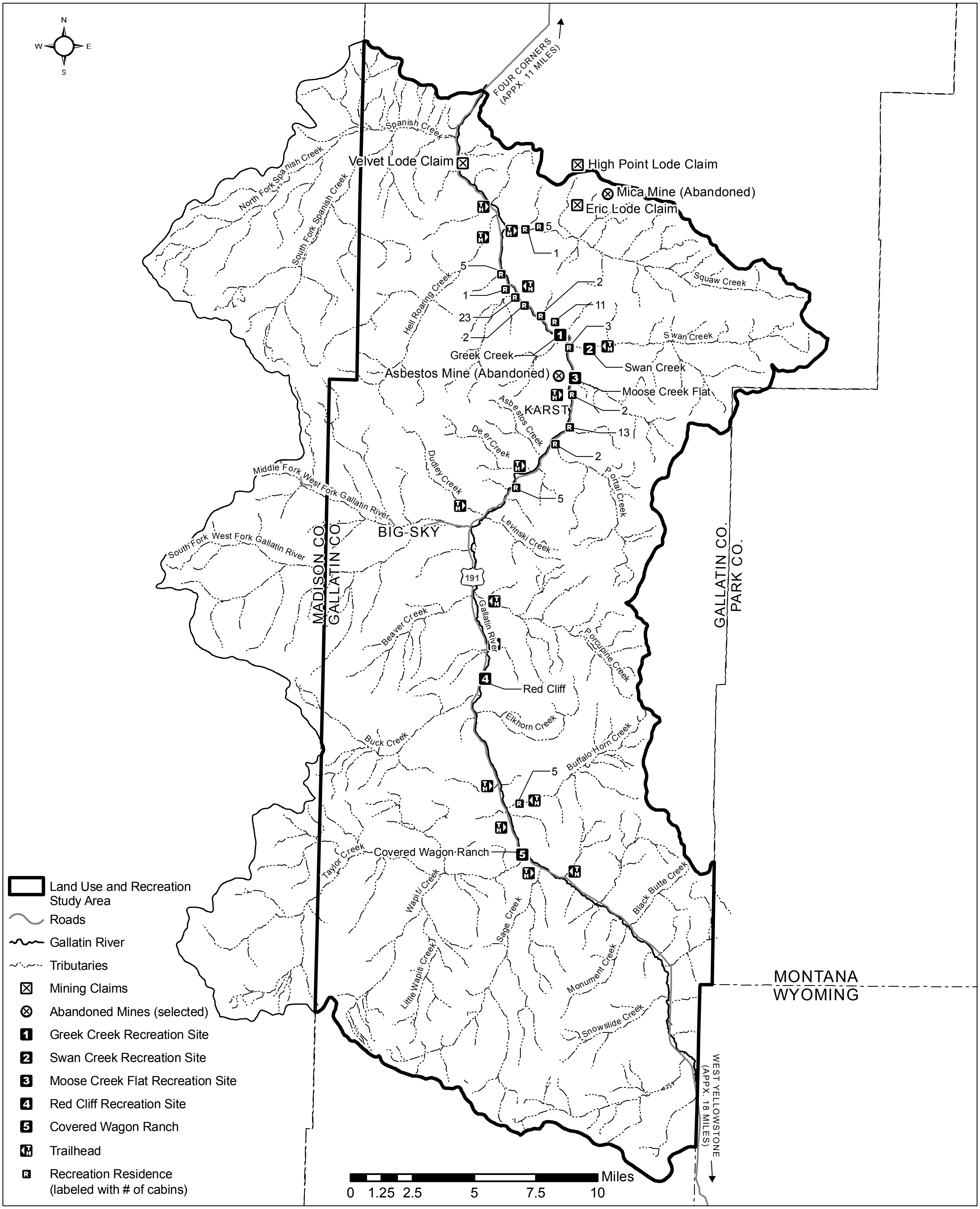

FIGURE 3-4-2

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PUBLIC LAND PROGRAMS AND ACTIONS

GALLATIN RIVER ORW EIS

Private Land

Private land in the study area is under the jurisdiction of Gallatin County. Relevant countywide plans and regulations governing land use and development are the Gallatin County Growth Policy, adopted in 2003 (last updated in 2005) and the Gallatin County Subdivision Regulations, adopted in 2005. More detailed and area-specific land use and development regulations were adopted for two zoning districts within the ORW study area: the Gallatin Canyon/Big Sky Zoning District and the South Gallatin Zoning District. These conditions essentially divide the study area into three distinct land use planning and regulatory environments, as shown in Figure 3.4-1 and listed below.

Gallatin Canyon/Big Sky Zoning District
South Gallatin Zoning District
All other private land outside of these districts; for the purposes of ORW analysis, this means the area from the Spanish Creek confluence to just north of Karst (i.e., north of the Gallatin Canyon/Big Sky Zoning District).

The following discussions of land use plans and regulations governing private land in the ORW study area begin with a review of relevant provisions in the countywide Growth Policy and Subdivision Regulations. This is followed by discussion of each of three "sub-areas" identified above (individually, in the order listed above). These individual sub-area discussions are important because the countywide Growth Policy and Subdivision Regulations apply differently in each of the sub-areas, particularly in the two zoning districts where more detailed zoning regulations also apply.

Gallatin County Growth Policy (Gallatin County 2003)

The Gallatin County Growth Policy includes conservation of hydrologic resources and overall protection of the natural environment. Proposed development plans have to document efforts to ensure compatibility with the natural environment and existing use and provide provisions for mitigation of adverse impacts.

The first resource addressed in the Goals and Policies chapter of the Gallatin County Growth Policy is water quality, where Goal 1 is "Protect Water Quality." Policies under this goal related to the Proposed Action include:

1. Minimize adverse impacts of development on rivers, streams and riparian areas.
   - Encourage development that demonstrates adequacy of setbacks and buffers.
2. Require development to demonstrate compliance with local, state and federal water quality regulations and standards.
3. Encourage development to mitigate adverse impacts to neighboring properties, rivers, streams and riparian areas due to runoff.
   - Support an erosion control plan for major subdivisions at the time of preliminary plan submittal.
   - Encourage developers of minor subdivisions to document compliance with an erosion control plan prior to final plan approval.

4. Encourage multi-user or public water and wastewater treatment systems.
5. Limit development to appropriate uses in identified source water protection areas.
6. Encourage development to document efforts to protect water quality.
7. Encourage heavy industrial uses, including animal feeding operations, to document mitigation of adverse impacts on surface and ground waters.

Policy 3 under "providing for local services and public facilities" is also relevant to protection of water quality, and states:

Encourage development to use multi-user public water and wastewater treatment systems.

- Support the expansion of existing municipal and private urban service systems.
- Support the development of new private urban service systems. Encourage "county sewer and water districts" for all new multi-user and public water or wastewater treatment systems.

The Gallatin County Growth Policy identifies the Subdivision Regulations as the primary tool for implementation of its goals and policies on a countywide basis. The Gallatin County Growth Policy regarding subdivision review states that all proposed subdivisions will be evaluated for their effect and potential for significant, unmitigated, adverse impacts on the natural environment (among other factors) including, "runoff reaching surface waters (e.g., streams, rivers or riparian areas)" and "effects on…quality or quantity of surface or ground waters." However, the Gallatin County Growth Policy itself does not specify setbacks or other measures to avoid or mitigate such impacts.

Gallatin County Subdivision Regulations (Gallatin County 2005a)

Provisions in the Subdivision Regulations that are specifically relevant to analysis of the proposed ORW designation are those addressing development relationships with surface waters and solutions to wastewater management. Relevant provisions are (excerpted from the regulations):

General Standards:

- Conformance: The design and development of a subdivision shall conform to adopted growth policies or comprehensive plans, zoning regulations and other resolutions and regulations.
- Natural Environment: The design and development of the subdivision shall, insofar as it is possible, preserve or enhance…natural drainage, floodplain, existing topsoil, trees, and natural vegetation.
- Watercourse Mitigation: Where a subdivision is crossed by or adjacent to a watercourse, the subdivider shall mitigate the impacts of the subdivision on the watercourse. This mitigation may not be less restrictive than the requirements of the Gallatin County Floodplain Regulations or any applicable zoning regulations. As described below, the subdivider shall provide watercourse setbacks or a watercourse mitigation plan.
- Setback: The subdivider shall provide the following setbacks, which parallel the ordinary high water mark of the watercourse. A 300-foot setback shall be provided

between the ordinary high water line and any residential or commercial structure, excluding structures used for agricultural purposes or for the maintenance of livestock, along the following rivers: the East and West Gallatin. A 150-foot setback shall be provided from the ordinary high water line of all other watercourses.
- Watercourse Mitigation Plan: The subdivider shall submit a plan, and propose measures to mitigate the impacts of the subdivision on the watercourse. The plan shall evaluate the potential effects of the proposed subdivision on the watercourse; to include consideration of wildlife and fish habitat, water quality, vegetation, and watercourse health. The mitigation measures might include: setbacks (i.e., increased or reduced, based on site-specific conditions), changes in building design, landscaping, type and/or location of septic systems, stream bank stabilization, etc.

Sanitary Sewers:

- Where the subdivision is within the service area of a public sanitary sewer system, connect with and install facilities in accordance with the requirements of the DEQ and sewer district involved.
- Where lots cannot be served by the extension of an existing public sanitary sewer system, the subdivider shall obtain approval of lot sizes for individual septic tanks and disposal fields or approval of neighborhood disposal systems from DEQ and the Health Department.

Gallatin Canyon/Big Sky Zoning District

The Gallatin Canyon/Big Sky Zoning Regulation was adopted in 2002 and last updated in 2004. Zoning districts in Gallatin County are intended to supplement and be consistent with the Growth Policy and Subdivision Regulations. These districts assign specific land use (zoning) designations to all private lands within their boundaries, indicating both the type of land use allowed and its density/intensity.

Zoning classifications assigned to private lands in the Gallatin Canyon/Big Sky Zoning District are shown in Figure 3.4-3 and described in Tables 3.4-2 and 3.4-3. For the residential classifications, Table 3.4-2 notes minimum lot sizes and allowable densities; however, for the commercial and other classifications (Table 3.4-3), no firm development density or intensity standards are specified in the regulation. Maximum building heights are set, but no maximum building coverages (e.g., square feet of building footprint per acre) are specified. Allowable development intensity in these classifications is determined on a case-by-case basis, dependent on site conditions and response to requirements for parking, open space, and setbacks from roadways, adjacent lots, etc.

Table 3.4-2. Gallatin Canyon/Big Sky Zoning: Residential Classifications

Residential	Lot Size	Dwelling Unit Density Limits
Town Center—mix of:		
- Multi-Family	Variable	8 to 15 per acre
- Single Family	Variable	4 to 6 per acre

Table 3.4-2. Gallatin Canyon/Big Sky Zoning: Residential Classifications

Residential	Lot Size	Dwelling Unit Density Limits
Multi-Family 3500	3,500 square feet[a]	12 per acre
Multi-Family 6500	6,500 square feet	6.7 per acre
Mobile Home 6000	6,000 square feet	7 per acre
Single Family 7500	7,500 square feet	5.8 per acre
Single Family 11000	11,000 square feet	4 per acre
Cluster Single Family 1	1 acre[b]	1 per acre
Cluster Single Family 2.5	2.5 acres	1 per 2.5 acres
Cluster Single Family 5	5 acres	1 per 5 acres
Cluster Single Family 10	10 acres	1 per 10 acres
Cluster Single Family 20	20 acres	1 per 20 acres
Cluster Single Family 40	40 acres	1 per 40 acres
Cluster Single Family 100	100 acres	1 per 100 acres

[a] In the residential cluster classifications, a minimum of 40% of the land must be left in contiguous, usable open space. The allowed dwelling units are then clustered (or grouped) on the remaining land where individual lot sizes for the residences can be highly variable, based on site-specific conditions.

[b In] the residential cluster classifications, density bonuses can be obtained by preserving higher percentages of the land in open space beyond the minimum 40% required. This means that a higher number of units can be built if a higher percentage of open space is set aside. These bonuses are: 10% more units if 50% of the land is retained in open space, 15% more units for 60% open space, 20% more units for 70% open space, and 25% more units for 80% open space

Table 3.4-3. Gallatin Canyon/Big Sky Zoning District: Commercial, Community and Other Classifications

Commercial	Description
Commercial & Industrial Mixed	Areas for commercial and service enterprises to serve the traveling public and local residents, and areas for light industrial uses; multi-family residential up to 12 Dwelling Units/Acre with a Conditional Use Permit (CUP).[a]
Community Commercial	Unified development of community retail, service and office facilities with convenient auto access; maximum building height of 35 feet; multi-family residential up to 12 Dwelling Units/Acre with CUP.
Meadow Center	Pedestrian-oriented, central location for basic services, shopping, employment and housing; maximum building height of 25-35 feet; multi-family residential up to 12 Dwelling Units/Acre with CUP.
Recreational Business	Large-scale recreational activities (and retail/service activities frequently required by recreationists); maximum building height of 35 feet.
Resort	Planned resort development that includes visitor accommodations, residential uses, recreational facilities and food service; maximum building height of 35 feet. Includes single- and multi-family dwellings, along with hotels, motels, etc.
Town Center	Pedestrian-oriented, local-serving and visitor-serving center containing retail, office, public, quasi-public, recreational, parks, open space, trails and residential uses; provides a location for local and visitor-serving services, shopping, employment, and housing; maximum building height of 35-50 feet; multi-family residential up to 15 Dwelling Units/Acre with CUP.
Community Facilities	Public or semipublic community facilities.
Community Recreation	Public or private recreation lands (e.g., parks, trails, golf courses, etc.).
Open Space Preserve	Preservation of the environmental quality, wildlife habitat and undeveloped character of designated open space lands (i.e., no development).

[a] In this land use classification, as well as the Community Commercial, Meadow Center, and Town Center Commercial uses, multifamily residential is permitted on the second or subsequent floor as a conditional use (i.e., subject to obtaining a Conditional Use Permit).

The zoning district regulations also contain development standards related to stream access and preservation. These provisions apply to any application for a land use permit or subdivision on land located adjacent to or within 150 feet of the annual mean high water line of the Gallatin River and any other river or stream that flows year-round during years of normal rainfall. Design standards are:

- For all development and site modifications proposed by land use permit applications, minimum setbacks are 100 feet from the annual mean high water line of the Gallatin River and 50 feet from the annual mean high water line of other designated streams.
- For land use permit (development) applications on lots of record (i.e., legally subdivided or recorded prior to1996 amendment of the zoning regulation), minimum setbacks are 50 feet from the annual mean high water line of the Gallatin River and 25 feet from the annual mean high water line of other designated streams.
- On new subdivisions of land, the minimum setback requirements (with provision for a Watercourse Mitigation Plan) specified above for the County Subdivision Regulations apply (i.e., 300 feet for the Gallatin River; 150 feet for other designated streams).

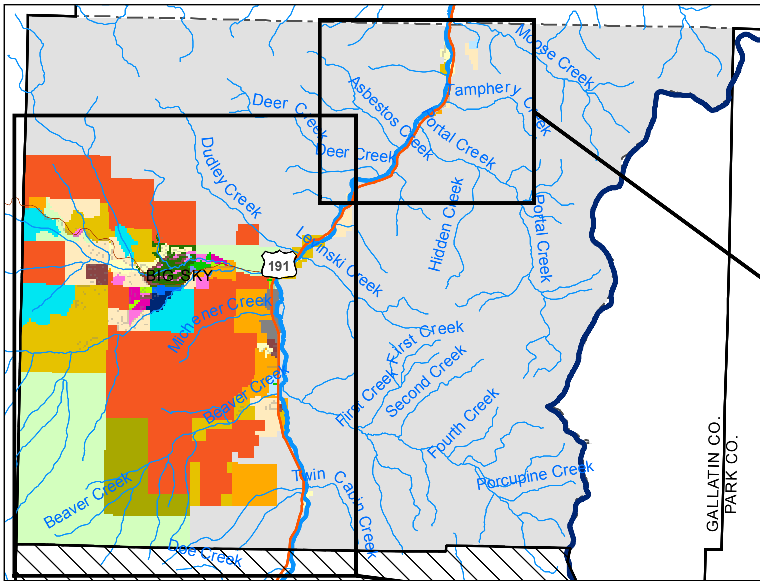
South Gallatin Zoning District

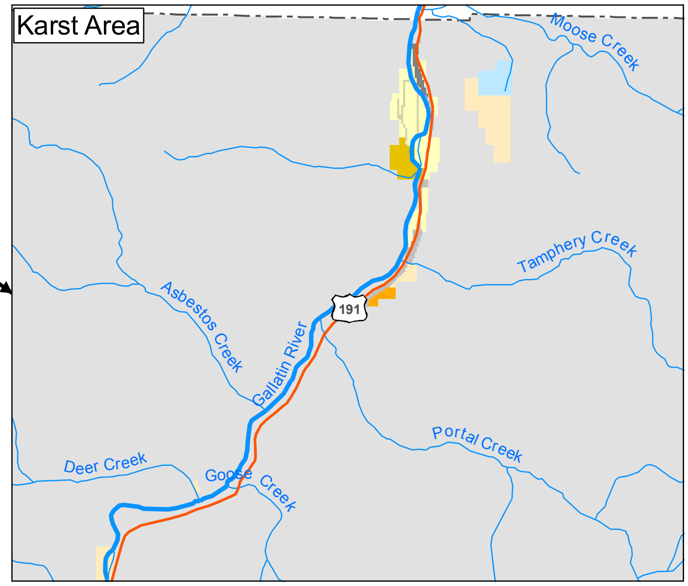
The South Gallatin Zoning Regulations were originally adopted in 1994 and last updated in 2002 (Gallatin County 1994). Zoning classifications assigned to private lands in the South Gallatin Zoning District are shown in Figure 3.4-4 and described below.

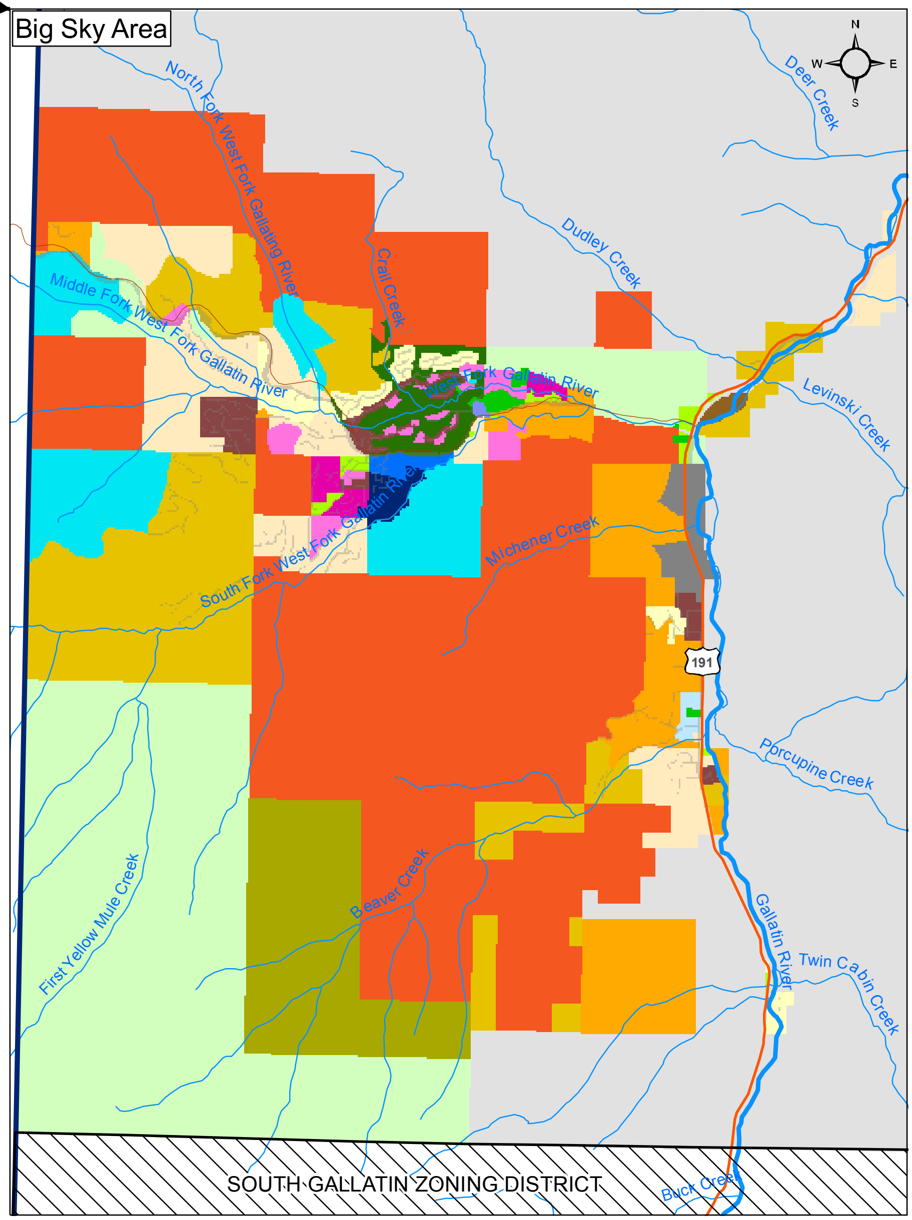
The Recreation and Forestry classification is assigned to most private land in the South Gallatin Zoning District. It is intended to provide areas for recreational activities, wildlife habitat and limited year-round single-family residential life. It is intended that this land remain a very low development density area to protect natural, scenic and environmental qualities. Typical uses include guest ranches, recreation and logging.

Single-family dwellings are permitted at a density of one unit per 100 acres (two units per 100 acres with a Conditional Use Permit if the dwellings are clustered on 10% or less of the land). Other land use intensity specifications for this classification includes corporate retreats (minimum 640 acres), dude ranches (minimum 640 acres), and private clubs (minimum of 320 acres).

The Canyon Commercial classification occurs in two proximate locations in the north-central part of the South Gallatin Zoning District, along U.S. Highway 191. This classification provides for limited retail development in appropriate locations including commercial services necessary for the population within the region. Other allowed uses include limited guest services (including restaurants - two maximum per Canyon Commercial District location), clustered guest cabins, guest ranches/resorts, and single-family dwellings at a density of one unit per three acres.







Land Use and Recreation Study Area

Zoning Classifications

Residential

- TCR: Town Center Residential
- R-MF-3500: Residential Multi Family 3,500 sf
- R-MF-6500: Residential Multi Family 6,500 sf
- R-SF-7500: Residential Single Family 7,500 sf
- R-SF-11000: Residential Single Family 11,000 sf
- RC-SF-1: Residential Cluster Single Family 1 ac
- RC-SF-2.5: Residential Cluster Single Family 2.5 ac
- RC-SF-5:: Residential Cluster Single Family 5 ac
- RC-SF-10: Residential Cluster Single Family 10 ac
- RC-SF-20: Residential Cluster Single Family 20 ac
- RC-SF-40: Residential Cluster Single Family 40 ac

Commercial

- CI: Commercial and Industrial Mixed
- CC: Community Commercial
- MC: Meadow Center
- RB: Recreational Business
- R: Resort
- TCC: Town Center Commercial
- CF: Community Facilities
- CR: Community Recreation
- OSP: Open Space Preserve

Other

- PL: Public Lands
- Roads

FIGURE 3-4-3

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GALLATIN CANYON / BIG SKY ZONING DISTRICT MAP

GALLATIN RIVER ORW EIS

The Canyon Residential classification applies to three small areas along U.S. Highway 191, in the north-central part of the South Gallatin Zoning District. Two of these areas are adjacent and related to, the Canyon Commercial areas noted above. The Canyon Residential classification is intended to accommodate residential development at maximum densities of one unit per 3 acres in limited areas in close proximity to U.S. Highway 191.

Water quality protection measures in the South Gallatin Zoning District are applied similarly to that in the Gallatin Canyon/Big Sky Zoning District.

- For lots of record, where development is proposed with no subdivision of land required, the South Gallatin Zoning District setback standards apply. These are: 50 feet from the mean high water line of the Gallatin River and the Taylor Fork; and 25 feet from the mean high water line of all other streams. In these setbacks, no development or alteration of the natural environment is allowed. However, nothing in this standard is intended to prohibit repairs or improvements to existing roads, ditches, utilities or utility lines or bank maintenance or stream stabilization measures otherwise allowable under federal or state laws.
- For new subdivisions of land, the minimum setback requirements (with provision for a Watercourse Mitigation Plan) specified above for the Gallatin County Subdivision Regulations apply (i.e., 300 feet for the Gallatin River; 150 feet for other streams).

Spanish Creek-North Karst Area

Private land in this northernmost portion of the ORW study area is not zoned. The only land use planning and development regulations that apply here are the County Growth Policy and Subdivision Regulations described above. The Growth Policy provides only the most generalized indication of allowable land use in the unzoned areas of the county. Figure 3.4-5 shows the portion of the Growth Policy’s Land Use Diagram covering the Spanish Creek-Karst area. Within this area, private lands are designated either Rural or Conservation easements.

The Rural designation includes “Gallatin County’s farm and ranch lands, and portions of the county that are currently without zoning or neighborhood plan.” Beyond this description, no specification of allowable uses or development densities or intensities is provided. In these areas, unless a subdivision of land is involved, no regulation of land use or development occurs; and no setbacks from rivers and streams are required unless other regulatory mechanisms such as flood plain management or septic tank leach field siting review applies. However, proposed subdivision projects are reviewed based on compliance with goals and policies of the Gallatin County Growth Policy and the standards in the Subdivision Regulations (including those for watercourse mitigation).

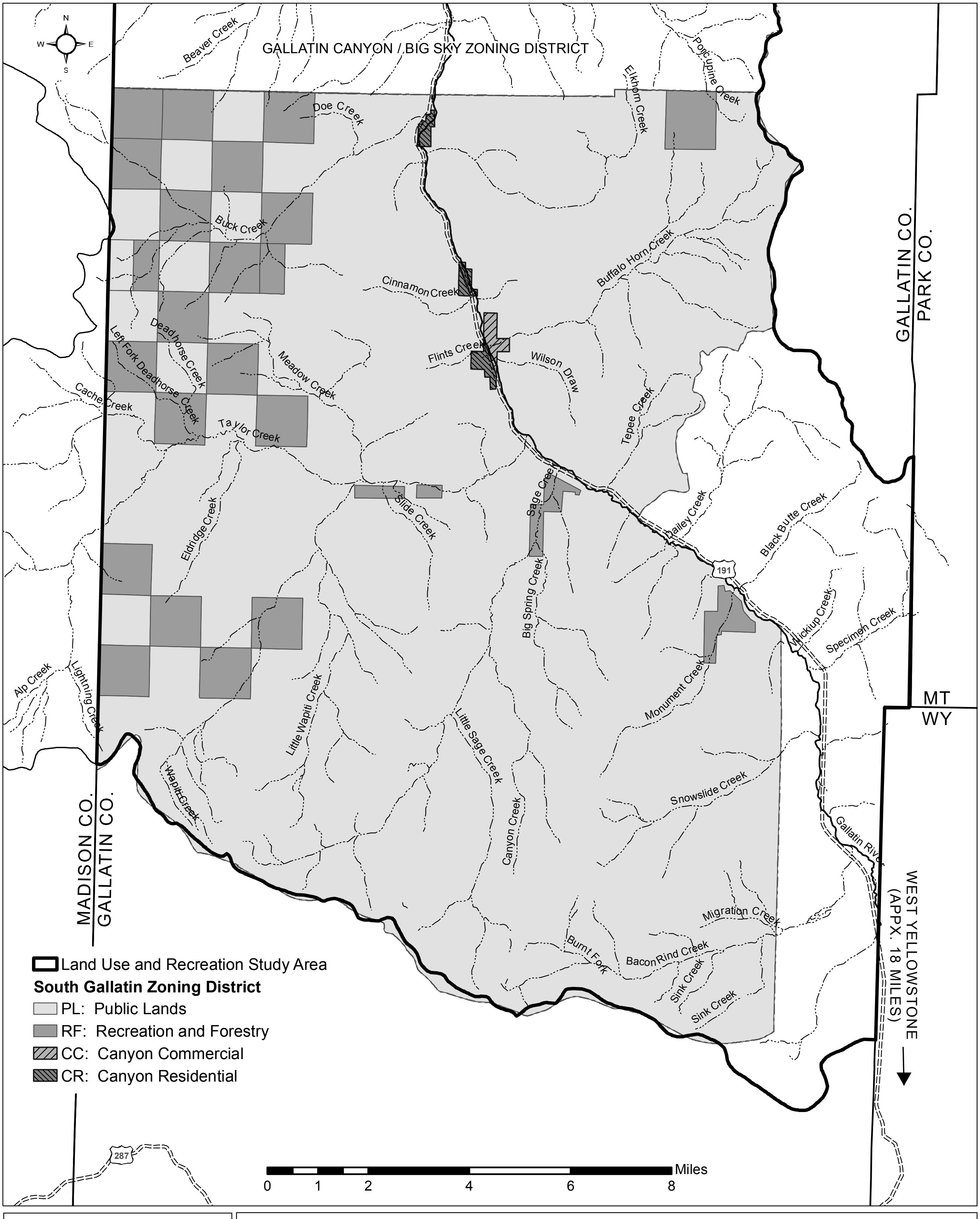

FIGURE 3-4-4

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SOUTH GALLATIN ZONING DISTRICT MAP
GALLATIN RIVER ORW EIS

As illustrated in Figure 3.4-5, a substantial proportion of private land in the Spanish Creek-Karst area is in conservation easements. These easements are placed on the land either voluntarily by the landowners or through purchase of the easement by a local jurisdiction or interest group such as The Nature Conservancy. In the latter regard, in the fall of 2000, voters passed the Gallatin County Open Space Bond, establishing $10 million in bond money to be used to preserve open space in Gallatin County by purchasing land and conservation easements from willing landowners. Generally, conservation easements specify that no increase in land use intensity and no further subdivision can occur. The large conservation easement along Spanish Creek is on the Turner Flying D Ranch and is managed by The Nature Conservancy. This easement was established in 1989 and covers the entire ranch, approximately 107,000 acres, and includes much of the Spanish Creek watershed (Figure 3.4-5) (B. Martin, pers. comm. 2006 and R. Miller pers. comm.. 2006). The easement allows: 1) all land uses and existing buildings (11 bunk houses and 22 residences) on the property at the time of easement to persist; and 2) permits a maximum of 10 additional dwellings to be added ranch-wide (subject to siting approval by the Nature Conservancy); and 3) prohibits any further subdivisions of the land (B. martin pers. comm. 2006 and R. Miller pers. comm. 2006). Although the easement allows for up to 10 additional dwellings, there are no current plans for building these units, and protection of water quality (no degradation) would be an important criterion in any future plans for siting and building on the ranch (R. Miller Pers. comm. 2006).

3.4.3.3 Current Land Use Patterns and Trends

Federal Lands

Relevant aspects of existing land use and resource management conditions and trends on the federal lands in the ORW study area are those that have or could have a relationship with the long-term water quality of the proposed ORW reach of Gallatin River. These include land exchanges, logging, fuels management, mining, developed recreation sites, recreation residences (under special use permits), grazing and range management, and road development, and are discussed above in Section 3.4.3.2, in context with Forest Service plans and management programs. The basic findings contained in these discussions include:

No significant land exchanges are in process or anticipated.

Fuels management activities, including controlled burns and thinning, are ongoing in limited areas and such activities will continue as a long-term forest management program; all such activities are being designed and implemented to avoid significant water quality impacts.

No logging operations are on-going; logging associated with two prior timber sales has ended and effected lands are now being actively managed to protect water quality; no substantial logging projects are anticipated for the reasonably foreseeable future.

No active mining is occurring or anticipated in the study area; historic mine sites are all closed or abandoned, and none discharge to the ORW reach.

Recreation sites and recreation residences are present along and near the ORW reach; there is no current plan to expand these developments, either at existing or new locations.

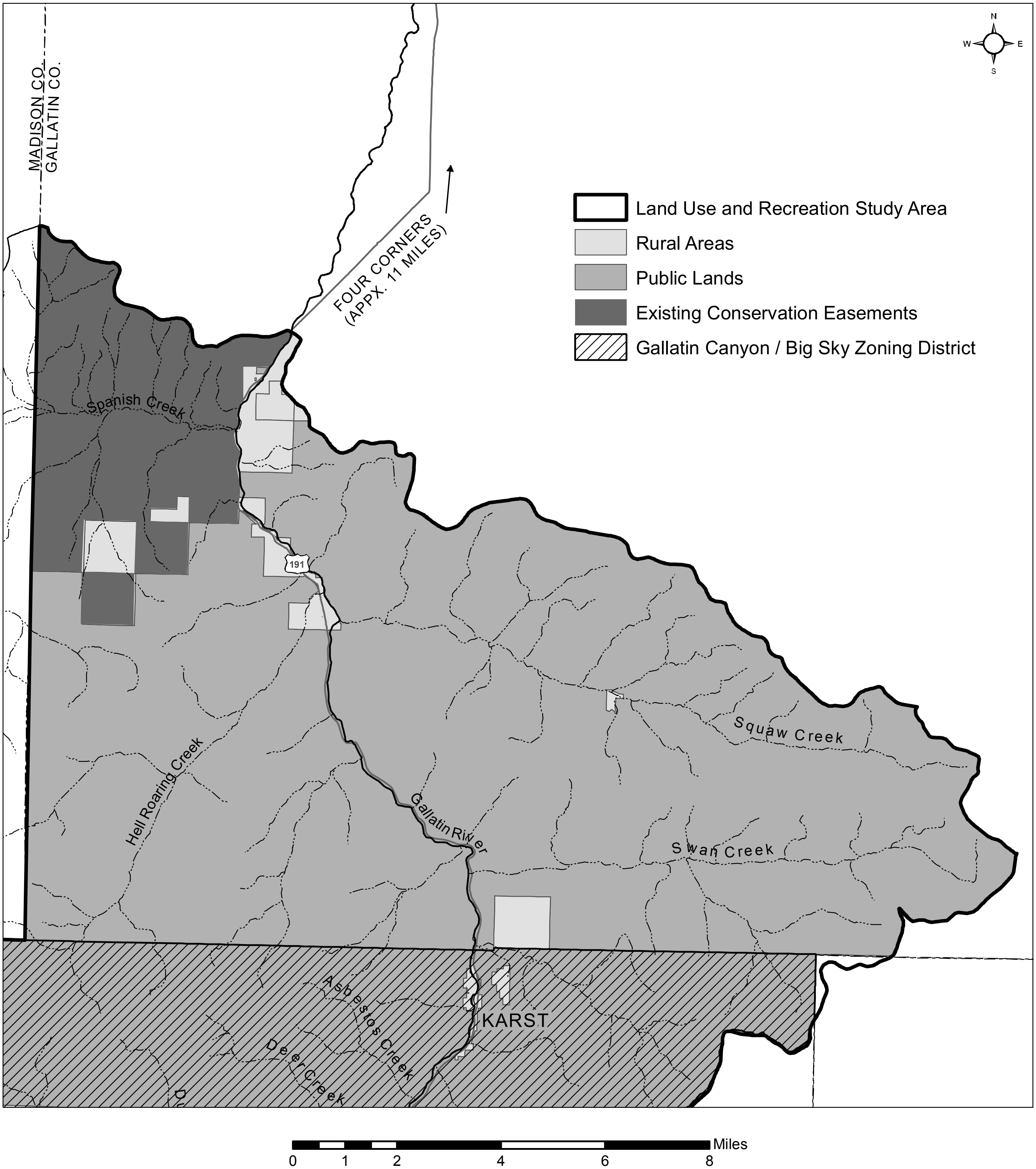

FIGURE 3-4-5

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LAND USE DESIGNATIONS:
SPANISH CREEK TO NORTH OF KARST
GALLATIN RIVER ORW EIS

- Grazing is an ongoing activity in the area; however, the trend is toward increasingly stringent management requirements on grazing allotments (with one major motivation being protection of water quality). In addition, changes in surrounding land use and demographics have also altered the demand for grazing lands. As a result, the level of grazing activity is declining.
- Much of the federal land in the study area is roadless and there are no plans to open new areas to vehicular access. Some areas that have a high density of roads are being reviewed as part of the ongoing travel management planning process with the view toward closing unneeded roads and restoring or revegetating road corridors, while maintaining public recreational access.

State Lands

As noted in Section 3.4.3.2, most of the state lands in the ORW study area are part of the Gallatin Wildlife Management Area. Given this status, management emphasis is on protecting wildlife habitat values in conjunction with adjacent federal lands. Human use is limited to wildlife-oriented recreation and is regulated via (1) designated hunting seasons, (2) seasonal closures to all public access (e.g., the lands adjacent to Big Sky - see Figure 3.4-1 - are closed from December 1 to May 1 each year), and (3) the absence of developed day-use or overnight recreation sites. No changes in use or management direction are occurring or anticipated on these lands.

Private Lands

The following discussions provide a general overview of (1) current developed land uses along the proposed ORW reach and tributaries of the Gallatin River where there are concentrations of private land; (2) the extent to which private land is currently undeveloped (or subject to more intense development based on county plans or zoning classifications): and (3) trends in the pace of or pressure for new development. Related to the second of these perspectives, a more detailed, quantitative analysis of development potential (i.e., build-out potential) on currently undeveloped or partially developed lands is provided as part of the impact analysis in Chapter 4. The focus on currently undeveloped or partially developed lands is because those lands would be most directly affected by restrictions associated with ORW status.

The land use patterns and trends overview is provided for each of three sub-areas identified in Section 3.4.3.2, and is presented in the same geographic order used in that section (i.e., beginning with the Gallatin Canyon/Big Sky and South Gallatin zoning districts, and ending with the area between the Spanish Creek confluence and Karst).

Gallatin Canyon/Big Sky Zoning District

Within this zoning district, most developed land is concentrated in the Big Sky area, along the Gallatin River and West Fork of the Gallatin River and their tributaries.

From the junction of U.S. Highway 191 and the Big Sky Spur Road, developed uses to the north occur in two main areas:

- Immediately north of the junction along an approximately three-mile section of U.S. Highway 191, where development occurs in a narrow corridor along both sides of the highway and the Gallatin River. In this area, beyond a small commercial area at the highway

junction, development is residential with mostly low density, multi-acre lots. Roughly a third of the land in this area is currently undeveloped or only partially developed.

- The Karst area, roughly seven miles north of the junction. Aside from small commercial enterprises (e.g., rafting business), existing development in this area is also primarily low density residential, with one acre or larger lots. Roughly a third to half of the land in this area is undeveloped or partially developed.

Along U.S. Highway 191 south of the Big Sky Spur Road junction, the developed area extends approximately three miles along both sides of the highway, generally west of the Gallatin River. Development includes the only current instance of commercial and light industrial mixed use in the Big Sky area, as well as community commercial, recreation business, and community facilities (e.g., schools). Residential uses are also present, with low density cluster residential predominating (i.e., five- , ten- and twenty-acre lots). Small areas of residential development at four to six units per acre also occur. Over half of the land in this corridor is currently undeveloped or is developed at a lower intensity than allowed by underlying zoning. This condition applies to all or most land use classifications present.

Most developed land use in this zoning district occurs west of Highway 191, both north and south of the Big Sky Spur Road and along the West Fork of the Gallatin River and its tributaries. Here, the developed area stretches several miles to the west, to the Gallatin County border and beyond into Madison County (outside the ORW study area). The developed and developing area is over two miles wide in some areas along Big Sky Spur Road and contains a variety of uses (essentially all of the uses depicted on the area's zoning map--see Figure 3.4-3). Roughly a third of land in this area is presently undeveloped or partially developed.

The highest proportion of both developed and developable land in the ORW study area is concentrated in the Gallatin Canyon/Big Sky Zoning District. In all privately owned areas of the district, growth pressure is high and new development activity is widely in evidence. In fact, the Big Sky area is one of the fastest growing in all of Gallatin County, based on data contained in a recent analysis by Gallatin County Planning Department (Gallatin County 2005b) and shown on Tables 3.4-4 and 3.4-5. Table 3.4-4 illustrates that this zoning district was one of the three fastest growing over the past several years among the 16 zoning districts in the county, as measured by number of land use and development permits issued. Table 3.4-5 illustrates the increasing pace of growth in land use permit activity within the Gallatin Canyon/Big Sky Zoning District itself over the same period.

Table 3.4-4. Land Use Permits (LUPs) Issued-County Fiscal Years 2000-2004 and the First Half of 2005. [a]

Zoning District	LUPs Issued	Percent
Big Sky	416	21.0
River Rock	639	32.2
Gallatin Co./Bozeman Area (aka Donut)	467	23.6
Hebgen Lake	98	4.9
Bridger Canyon	87	4.4
Bear Canyon	87	4.4
Hyalite	59	3.0

Table 3.4-4. Land Use Permits (LUPs) Issued-County Fiscal Years 2000-2004 and the First Half of 2005. [a]

Zoning District	LUPs Issued	Percent
Trail Creek	43	2.2
Middle Cottonwood	34	1.7
Springhill	27	1.4
Zoning District #1	8	0.4
South Gallatin	7	0.4
Sypes Canyon#1	5	0.3
Wheatland Hills	3	0.2
Zoning District #6	2	0.1
Sypes Canyon#2	1	0.1
Total	**1983**	**100**

[a] County fiscal year is July 1 to June 30. The period for which data are reported is July 1, 1999 through December 31, 2004

Table 3.4-5. Land Use Permits (LUPs) Issued in Gallatin Canyon/Big Sky Zoning District- County Fiscal Years 2000-2004 and the First Half of 2005.

Fiscal Year	LUPs Issued
2000	56
2001	45
2002	77
2003	83
2004	94
2005 (first half)	61

South Gallatin Zoning District

Existing development in this zoning district is primarily visitor-oriented, including restaurants and guest lodging located on private lands along Highway 191. The private lands roughly one-half mile south of the zoning district boundary along the highway host the Corral Steakhouse Cafe and Rainbow Lodge (both restaurant and lodging) (Figure 3.4-4). Cinnamon Lodge (restaurant and guest cabins) is approximately 5 miles south of the district boundary. Low density residential uses (i.e., three or more acres per dwelling unit) are also present in this area. Two large-acreage guest ranches, the 320 Guest Ranch and the Elkhorn Dude Ranch, occupy the 300+ acres of private land along the highway roughly 6 miles south of the district boundary. Beyond these uses, there is very little development within the South Gallatin Zoning District. South of the 320 and Elkhorn ranches, and throughout the rest of the district, all private land is designated as Recreation and Forestry (see Section 3.4.3.2), and the scattered “developed” uses present are consistent with that land use classification. The primary example of this condition is the 9 Quarter Circle Dude Ranch along the Taylor Fork.

Only small acreages of private land designated by the county for Canyon Residential or Canyon Commercial uses are undeveloped at present. These are all within the private lands along the highway within roughly 5 miles of the northern district boundary. Much of the private land (all

designated Recreation and Forestry) elsewhere in the district is undeveloped. Based on the scale and rate of development to date, further development in the district can be expected at a relatively slow pace.

Spanish Creek-Karst

In this unzoned area north of the Gallatin Canyon/Big Sky Zoning District, private land is concentrated along and immediately south of Spanish Creek. Lands along Spanish Creek from its confluence with the Gallatin River are in conservation easements and are generally undeveloped except for scattered ranch buildings. Approximately 1.5 miles south of the Spanish Creek confluence, developed uses are scattered on private lands along and on both sides of a roughly 4-mile segment of U.S. Highway 191. Development is predominantly low density residential. Small, scattered commercial enterprises are also present, including a motel, guest cabins, a rafting business, and community facilities, such as a church camp. Approximately half of the private land along this corridor is undeveloped. New, predominantly residential development activity is occurring; however, most of this activity is on existing lots, with no requirement for land use approvals by the county. Due to this condition, no specific documentation exists of the rate or character of new development in this area.

3.4.3.4 Recreation

This section focuses on water-based recreation activities on the proposed ORW reach of the Gallatin River. Information on developed recreation sites along the Gallatin River is included in the land use discussions above.

The top water-based recreation activities along the ORW reach are fishing and whitewater boating (rafting and kayaking). Other important activities include wildlife-based recreation (wildlife viewing and hunting), walking, hiking, picnicking, camping, nature photography, and environmental education.

Fishing

The entire proposed ORW reach of the Gallatin River is classified as a Class I “Blue Ribbon” sport fishery (FWP 2000), and has been listed in Trout Unlimited’s Guide to America’s 100 Best Trout Streams (Ross 1999). The sport fishery class rating is based on fish abundance, fishing pressure, aesthetics, and ease of access. The river and its tributaries support native westslope cutthroat trout, mountain whitefish, and mountain sucker, as well as other trout and hybrid trout/cutthroat species. Section 3.7.3 provides more detail on the fish species present.

Angler use of the Gallatin River from Spanish Creek to the headwaters of the Gallatin within Yellowstone National Park was estimated at 31,485 angler days in 2003, the most recent data available (McFarland and Tarum 2003). Of these, 33% (10,242) were resident angler days and 67% (21,243) were nonresident angler days. In 1999, this reach of the Gallatin River experienced 24,418 angler days, of which 42% (10,344) were reported to be resident and 58% (14,084) were nonresident (Figure 3.4-6). Although many factors contribute to the magnitude of fishing use on an annual basis (including variations in runoff and other hydrologic variables), these data suggest that the popularity of the Gallatin River in the proposed ORW study area is increasing. Further, while resident angler use remained nearly constant between 1995 and 2003, nonresident use increased by 50% (more than 7,400 angler days) (MFISH 2006) (Figure 3.4-6).

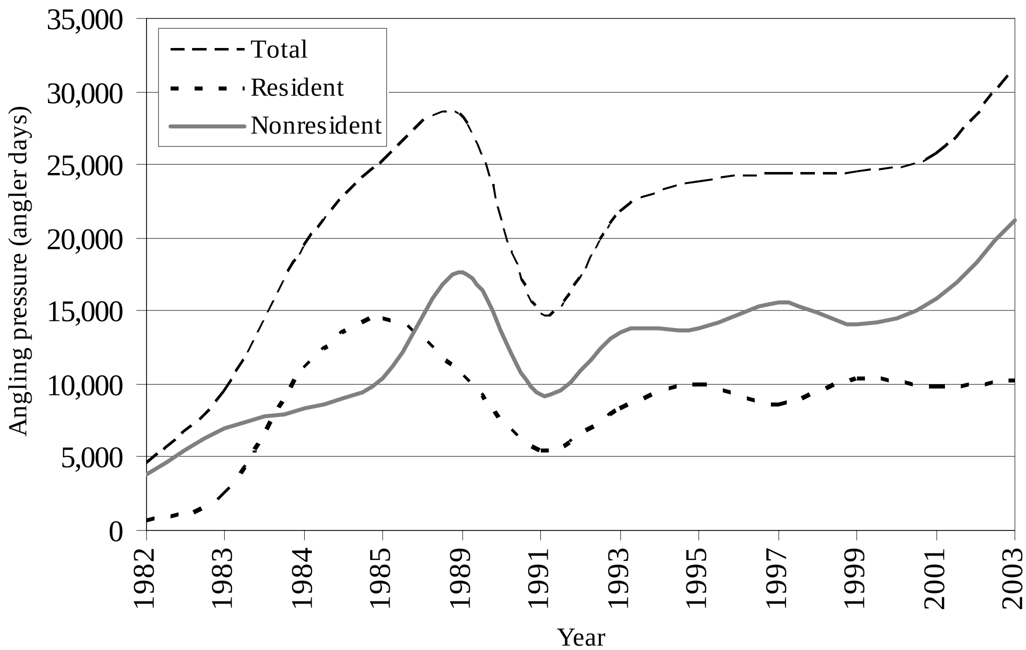

Figure 3.4-6. Angling pressure measured in angler days for the Gallatin River from Spanish Creek to the headwaters in Yellowstone National Park from 1982 to 2003 (MFISH 2006).

No specific projections of future growth in fishing demand are available; however, past trends in fishing use, along with overall growth in regional population and out-of-state visitation, suggest that the level of fishing demand will continue to increase.

Commercial Whitewater Boating

The rapids on the proposed ORW reach of the Gallatin River are some of Montana's finest with tight turns, big rocks, and large waves. Some stretches have nearly continuous Class III whitewater, and the river is easily accessible from U.S. Highway 191 (Fischer and Raucher 1984).

Commercial rafting use has exploded on the river going from 300 rafter days in 1980 to 3,900 in a decade. More recent estimates (Forrest 1997) indicate that commercial rafting days have increased at an even faster rate during the 1990s, from 10,000 in 1992 to 20,000 in 1997 (i.e., a 100% increase over a 6-year period). Commercial kayaking is also increasing in popularity (Ripple Marketing LLP 1999), and data suggest that the majority of boaters are from out-of-state (Forrest 1997). There are no surveys available documenting growth in commercial boating use from 1997 to the present or projecting growth in demand into the future. As with fishing, the above data, along with overall growth in regional population and out-of-state visitation, suggest that the level of demand for commercial boating will continue to increase.

Noncommercial Boating and Recreation Use

There are no systematic surveys available of noncommercial boating and non-fishing recreational uses along the Gallatin in the ORW study area. However, a 1990 report on Missouri River Basin river recreation use, prepared for the Montana Department of Natural Resources and Conservation (Duffield et al. 1990) provides useful insights. Surveys and analysis from this report found that, in 1989, the angler proportion of all recreation use (excluding commercial boating) on the Gallatin River was 54% for state residents and 83% for nonresidents. In other words, aside from commercial boating users, about 54 out of 100 resident users in 1989, and about 83 out of 100 nonresident users, came for fishing.

These results translate to 46% of resident and 17% of nonresident users oriented to activities other than fishing or commercial boating. These numbers are the best available and, when used with the 2003 angler use figures reported above, result in estimates of 8,830 resident and 4,248 nonresident recreation user days (totaling 13,078) on the Gallatin River upstream of Spanish Creek centered on activities other than fishing or commercial boating.

The primary activities comprising this segment of recreation users in the study area include wildlife-based recreation (birding and other wildlife viewing and hunting), self-guided boating (rafting and kayaking), hiking, picnicking, camping, nature photography, and environmental education. There are no available local estimates of relative user participation in these other recreational pursuits; however, the statewide surveys reported in the 2003 State Comprehensive Outdoor Recreation Plan (SCORP) can provide some insight (FWP 2003). Relevant findings from these surveys are shown on Table 3.4-6.

Table 3.4-6. Montana Statewide Recreation User Participation in Non-Fishing, Non-Boating Activities.

Activity	**Participation**[a]	
	Residents	**Nonresidents**
Wildlife Watching	52%	14%
Day Hiking	37%	12%
Picnicking	31%	10%
Camping	23%	8%
Nature Photography	29%	NR[b]
Hunting	18%	1%
Nature Study	NR	4%

[a] Percentage of recreationists participating in these activities. Survey respondents were free to select all activities that apply to them, not just their top activity. Also, only those activities relevant to river environments like the ORW study area shown. For these reasons, neither column of percentages is intended to sum to 100%.
[b] Not Reported

Note: Non-commercial boating was not separately identified as a recreation activity in the SCORP surveys.

Attributes that Make the Gallatin River Special for Recreation Visitors

Visitor perceptions of the recreation experience along the Gallatin River are generally very positive. Factors contributing to a positive experience and user decisions to return include (May et al. 1997, Ripple Marketing LLP 1999):

- Canyon scenery--identified by the largest number (and roughly 50%) of respondents in a 1997 survey as the single most important positive factor influencing their use of the Gallatin River;
- Quality of the fishing experience, combined with river beauty and river conditions;
- Low levels of crowding and user conflicts; and
- Accessibility and services.

3.5 Socioeconomics

3.5.1 Overview

Study areas for EISs do not often perfectly match existing political divisions such as a county, city, or census districts. Three areas of differing size are used in this EIS to encompass the socioeconomics study area. The three areas are Gallatin County, West Yellowstone CCD (Census County Division—a subdivision of the county), and Big Sky CDP (Census Designated Place). Gallatin County is the largest geographic unit, and is dominated by the city of Bozeman. The West Yellowstone CCD reflects the portion of Gallatin County from West Yellowstone north to the Gallatin Gateway area, and encompasses much of the area around the ORW reach. Since Big Sky is not an incorporated town or municipality, the Big Sky CDP is used, which encompasses not only the area of Big Sky in Gallatin County but portions of Madison County where the Big Sky Resort is located.

MEPA requires a review of the beneficial aspects and economic advantages and disadvantages of a proposed action and the alternatives under consideration. In order to establish context for this review, information is included on the existing economic environment in the area surrounding the proposed ORW reach. Information related to demographics, income sources, population, and the economic value of natural resources in the area is provided to allow the reader to evaluate the potential impacts described in Chapter 4.

3.5.2 Inventory Methods

Much of the following data is drawn from the Sonoran Institute's (2003a) Economic Profile System (EPS) and EPS-Community or EPSC (Sonoran Institute 2003b), as well as the 2000 U.S. Census (U.S. Census Bureau 2000), and Montana Department of Commerce website (http://ceic.mt.gov). The Sonoran Institute's EPS and EPSC relies upon the 2000 U.S. Census for much of its demographic data, and the U.S. Bureau of Economic Analysis Regional Economic Information System (REIS) 2003 data for employment and income data by industry.

The baseline social and economic conditions of the study area are described in sections:

- A description of the human populations and the economy surrounding the study section of the Gallatin River (going from a broad view of Gallatin County, to the river corridor area, and then to the Big Sky area);
- On-site economic and social values arising from maintaining water quality for water based recreation such as fishing, boating, and aesthetics to both out-of-state visitors and Montana residents;
- A discussion of the value of water quality to residential property owners and residents of Montana (i.e., passive use values, option, existence, and bequest values) from maintaining the present water quality; and
- Types of costs anticipated with compliance with the ORW designation, if it becomes law.

3.5.3 Inventory Results

3.5.3.1 Population

The population of Gallatin County increased by 11.5% from 67,831 in 2000 to 75,637 as of 2005, according to the Montana Department of Commerce. This increase in population continues an existing trend, which Rasker and Hansen (2000) attribute to the abundance of natural amenities and the protection of those amenities in this region. Gallatin County's population is dominated by the city of Bozeman, which has become a year-round gateway to numerous outstanding recreation opportunities in the area, including skiing, hiking, rock and ice climbing, rafting, and fishing. The West Yellowstone CCD population was estimated at 2,887 for 2005, while Big Sky CDP was estimated at 1,221 residents (Table 3.5-1). These latter two populations increase with the arrival of summer and winter visitors, respectively. The West Yellowstone CCD has the highest median age at 38 years, followed by Big Sky CDP at 34 years, and Gallatin County at nearly 31 years.

Table 3.5-1. Population and median age in the study area (Sonoran Institute 2003a, 2003b).

	Gallatin County	West Yellowstone CCD	Big Sky CDP
Population	67,831	2,887	1,221
Median Age	30.7	38.1	34.3

3.5.3.2 Income

The three geographic areas have similar median household incomes: $39,688 for the Big Sky area, $38,793 for the West Yellowstone area, and $38,120 for Gallatin County as a whole (Sonoran Institute 2003a, 2003b) (Table 3.5-2). However, this similarity in median income masks the more than double percentage of households with an income of $125,000 and higher in Big Sky as compared to Gallatin County. In particular, 10% of households in Big Sky have household income of $125,000 or more, while 7% do in the West Yellowstone area and just 4% do in Gallatin County as a whole (Table 3.5-2). (These numbers refer only to full-time residents and do not include seasonal residents who rent or own homes in the Big Sky area, nor to tourists.)

Table 3.5-2. Distribution of household income in Big Sky, West Yellowstone area, and Gallatin County (Sonoran Institute 2003a, 2003b).

	Big Sky		**W. Yellowstone**		**Gallatin County**	
	Households	**% of Total**	**Households**	**% of Total**	**Households**	**% of Total**
Less than $10,000	30	5	76	6	2,139	8
$10,000 to $14,999	35	6	80	6	1,621	6
$15,000 to $19,999	36	6	119	9	2,178	8
$20,000 to $24,999	59	10	78	6	1,818	7
$25,000 to $29,999	55	9	109	9	2,089	8
$30,000 to $34,999	35	6	94	7	2,024	8
$35,000 to $39,999	46	8	105	8	2,000	8
$40,000 to $44,999	25	4	63	5	1,805	7
$45,000 to $49,999	26	4	48	4	1,410	5
$50,000 to $59,999	38	6	120	9	2,616	10
$60,000 to $74,999	49	8	123	10	2,403	9
$75,000 to $99,999	57	10	105	8	2,157	8
$100,000 to $124,999	38	6	63	5	1,015	4
$125,000 to $149,999	16	3	28	2	390	1
$150,000 or more	40	7	55	5	692	3
Total:	**585**	**100**	**1,266**	**100**	**26,357**	**100**
Median Income	$39,688		$38,793		$38,120	

Sources of Income

Table 3.5-3 compares the proportion of income earned in the West Yellowstone CCD and Big Sky CDP that is related to wages or salary (i.e., sometimes considered direct labor income), relative to other forms of income such as interest/dividends/net rental income, and retirement income sources. A substantial portion of income in the Big Sky area is obtained from interest/dividends/net rental income (nearly 21%) and retirement (nearly 7%) (Sonoran Institute 2003a, 2003b). While it was not possible to develop category by category comparisons for Gallatin County, the percentage of income from interest/dividends/net rental income and retirement income is 29% in Gallatin County, which is similar to the Big Sky CDP.

Table 3.5-3. Sources of income in the Gallatin Canyon.

	W. Yellowstone CCD		**Big Sky CDP**	
Sources of Income		**% of Total**		**% of Total**
Wage or Salary Income	$48,411,400	66.2	$23,815,100	61.8
Self-Employment Income	$5,546,100	7.6	$3,482,700	9.0
Interest, Dividends, or Net Rental Income	$12,761,300	17.4	$7,939,000	20.6
Social Security Income	$2,122,200	2.9	$905,200	2.4
Supplemental Security Income	$139,700	0.2	$12,000	0.0
Public Assistance Income	$19,900	0.0	$600	0.0
Retirement Income	$2,788,700	3.8	$1,751,700	4.5
Other Types of Income	$1,346,300	1.8	$603,500	1.6
Total	**$73,135,600**	**100**	**$38,509,800**	**100**

Source: Sonoran Institute (2003b)

3.5.3.3 Housing and Housing Affordability

Given the potential impact to development of the proposed action, it is important to evaluate the current housing affordability in Gallatin County, West Yellowstone CCD, and Big Sky CCP. Table 3.5-4 presents the median house price in each of the defined areas, and, using the 25% of median income guideline commonly used as a measure of housing affordability, the income necessary to purchase the median priced house (Sonoran Institute 2003b). Gallatin County as a whole is considered affordable since the income required to purchase the median home is quite close to the county's median income. The West Yellowstone area and the Big Sky CCP are less affordable as it would take a much higher percentage of these areas' median income to purchase the much higher median house prices. These house price statistics are from the 2000 Census and do not reflect the recent rather large increase in house prices (24% increase from 2001 to 2004 – see Polzin 2005), which has made areas in Montana less affordable than at the time of the 2000 Census. However, it is also worth noting that over half (57.3%) of housing in the Big Sky area is used primarily as seasonal, recreational or for occasional use, rather than being primarily owner occupied housing (U.S. Census Bureau 2000). Thus, the housing affordability issue in Big Sky is primarily a concern for workers and year-round residents, as compared to the people who use these homes as vacation rentals or have these houses as their second home.

Table 3.5-4. Housing affordability of Gallatin County, West Yellowstone CCD, and Big Sky CCP.

Owner Occupied Housing Affordability 2000	Gallatin County	West Yellowstone CCD	Big Sky CCP
Owner-occupied housing: Median price	$143,000	$196,500	$246,100
Income required to qualify for the median house	$40,407	$55,525	$69,540
Median Income for area	$38,120	$38,793	$39,688

Source: Sonoran Institute 2003a, 2003b

3.5.3.4 Employment Patterns

Table 3.5-5 presents the distribution of employment in the three areas. Perhaps the largest percentage difference in distribution between these three areas is in public administration (city, county, state, and federal government), which is ten-fold larger in Gallatin County as a whole compared to Big Sky and West Yellowstone. Other major differences between the areas include nearly double the percentage of employment in manufacturing, wholesale trade, and professional services in Gallatin County as compared to West Yellowstone and Big Sky. Alternatively, accommodations and food services are nearly triple the percentage of employment in West Yellowstone and Big Sky as compared to Gallatin County as a whole. The influence of tourism is clearly evident in the Big Sky area with one out of three workers directly employed in the hospitality sectors.

As is evident in Table 3.5-5, the employment pattern associated with an amenity-based economy is found in Big Sky with very little employment related to traditional sectors such as agriculture or mining.

Table 3.5-5. Employment by industry in Gallatin County and Gallatin Canyon areas displayed in terms of number of jobs per sector and percentage of the total.

	Big Sky CDP		W. Yellowstone CCD		Gallatin County	
Employment by Industry	**Number**	**%**	**Number**	**%**	**Number**	**%**
Agriculture, forestry, fishing, and hunting	8	1.0	27	1.5	1,655	3.1
Mining	4	0.5	2	0.1	176	0.3
Construction	110	13.9	164	9.2	5,249	9.7
Manufacturing	20	2.5	41	2.3	2,984	5.5
Wholesale trade	4	0.5	18	1.0	1,371	2.5
Retail trade	109	13.7	285	16.1	7,235	13.4
Transportation and warehousing	21	2.6	39	2.2	1,056	2.0
Utilities	4	0.5	8	0.5	n.d.	
Information	11	1.4	18	1.0	693	1.3
Finance and insurance	24	3.0	45	2.5	1,478	2.7
Real estate and rental and leasing	53	6.7	88	5.0	2,661	4.9
Professional, scientific, and technical services	24	3.0	64	3.6	4,020	7.4
Management of companies and enterprises	0	0.0	0	0.0	35	0.1
Administrative support & waste mgnt services	25	3.2	49	2.8	1,626	3.0
Educational services	16	2.0	60	3.4	650	1.2
Health care and social assistance	13	1.6	38	2.1	3,856	7.1
Arts, entertainment, and recreation	13	1.6	69	3.9	2,046	3.8
Accommodation and food services	298	37.6	643	36.3	5,721	10.6
Other services (except public administration)	23	2.9	67	3.8	2,746	5.1
Public administration	13	1.6	48	2.7	8,710	16.1
Total	**793**	**100%**	**1,773**	**100%**	**53,968**	**100%**
Based on employed civilian population 16 years & over						

Source: Sonoran Institute 2003a, 2003b

The remainder of this section discusses present economic values created from the Gallatin River, based on

- Gallatin River usage, including total annual numbers of anglers, shoreline and non-commercial boating users, and commercial rafting days
- Nonresident annual expenditures
- Number of jobs resulting from the Gallatin River, using economic multipliers and nonresident expenditures
- Net economic value of fishing and other recreation on the Gallatin River
- Value of water quality to residential property owners and residents of Montana, including non-use values

3.5.3.5 Overview of Components of On-site Recreation Use Values

The Gallatin River, and its associated water quality, fisheries, and recreation opportunities, provides several types of economic values to society. This section defines and estimates these values, and how the estimated values pertain to the present water quality of the Gallatin River. By defining and estimating the values of the Gallatin River and its present water quality, a benchmark is established by which to compare potential effects of each alternative.

The economic values of the Gallatin River can be categorized as those occurring on-site, such as recreation and values to nearby property owners, and those occurring off-site to non-visiting residents of Montana in the form of existence and bequest values. These off-site values are also referred to as non-use values. The on-site recreation values can be further subdivided into those received by the river users themselves (their net economic value or NEV) and the effect of out-of-state visitor expenditures on tourism economies. To provide an overview of recreation economic values and the value of water quality to property owners and non-visiting residents of Montana, the following relationship will be used:

Socio-Economic values of the Gallatin River = NEV_{rec} + $OSE_{ex+jobs}$ +NEV_{wq}+ NUV

Where:

NEV_{rec} = Net Economic Value of river recreation activities (fishing, commercial boating, non-commercial activities) to all river users

$OSE_{ex+jobs}$ = Nonresident visitor expenditures in Montana and associated Montana jobs tied directly to the river

NEV_{wq} = Net Economic Value of present Gallatin River Water Quality to Property Owners

NUV = Non-use values of the Gallatin River to Montana citizens.

Economic Effects of Fishing and other River Related Recreation on the Gallatin River

For the economic expenditure and valuation analysis, recreation use was grouped into three primary activities: (a) fishing; (b) shoreline and noncommercial boating use; and (c) commercial rafting. Annual economic effects and values are a product of annual visitor days and expenditures or values per visitor day, respectively. An expenditure is an actual amount of money paid for a service or good, while a value is measured as the extra amount a person would have paid, if necessary, to visit this particular recreation area.

3.5.3.6 Visitor Use

Gallatin River Angler Use and Its Response to Catch Rates

The most recent year for which angler use statistics are available is 2003. In that year, use was 10,242 resident angler days and 21,243 nonresident angler days, for a total of 31,485 angler days (McFarland and Tarum 2003). This statistic applies to the reach from the confluence with Spanish Creek to the headwaters in Yellowstone National Park, which includes approximately 13 miles upstream from the park boundary (outside the proposed ORW reach). It is well established that fishing use and benefits are tied to fish catch rates and the size of fish caught (Duffield et al. 1987, Duffield and Allen 1988). Potentially, ORW designation may prevent or reduce the extent to which water quality would deteriorate in absence of ORW designation. Maintaining water quality would likely maintain the high quality fishery in terms of catch rates, while lack of designation may allow the water quality to degrade more, potentially reducing fish catch rates, all else being equal. In anticipation of this possible linkage in the analysis of the alternatives, an assessment is provided of how fishing use changes with angler catch rates. In particular, Duffield et al. (1987) used a travel cost model to estimate how angler demand changes with fish catch rates. The coefficients in their model reflect a catch elasticity, i.e., how angler use of a given water body changes with a change in catch rate associated with that water body. Their two stream models estimate elasticities between 0.389 and 0.484. These estimates mean that a 10%

reduction in catchable trout would reduce angler use by between 4% and 5%. This result can be used to infer how angler use may change if water quality degrades and reduces fish catch.

Shoreline and Noncommercial Boating Use

Using the methodology discussed in detail in Section 3.4.3.4, we estimated 4,248 nonresident shoreline and noncommercial boating users, and 8,830 resident shoreline and noncommercial boating users. For the economic valuation and economic impact analyses, the total is used to obtain an estimate of 13,078 non-angling shoreline and noncommercial boating users on the ORW stretch of the Gallatin River. Floating is not permitted within Yellowstone National Park, and recreational boating is focused within the proposed ORW reach due to the concentration of whitewater rapids in this section.

Commercial Rafting Use

As discussed in more detail in Section 3.4.3.4, there were an estimated 20,000 commercial rafting days in 1997. The majority of floaters interviewed on the river in the user survey were from outside Montana (Forrest 1997).

3.5.3.7. Gallatin River Visitor Expenditure Analysis and Job Estimates

Expenditures made by visitors to the Gallatin River have a positive economic impact on tourism support industries (e.g., hotels, guides) and communities where expenditures are made. The commercial rafting companies and fly fishing stores in and around the Gallatin River corridor attest to the importance of river related recreation. As is standard in regional economic analysis (Crompton et al. 2001), and because the study area in this EIS is located completely within Montana, regional economists often do not count expenditures made by Montana residents as generating a new inflow of money to the Montana economy. Money spent by Montanans to Montanans is a transfer from one party to another whom live in the same region. Expenditures made by out-of-state anglers and visitors to the Gallatin River are included because they would not have been incurred in Montana without the river. As noted by Duffield et al. (1990: pp iv-v), “Similarly, nonresident expenditure was concentrated on streams and rivers (87%) as opposed to reservoirs. This indicates that from the standpoint of economic impact, far and away the most important resource in the basin is the streams in the Upper Basin region, including the Madison, Gallatin, Jefferson, Beverhead (sic) and Big Hole. These waters are destination fisheries.”

Nonresident Angler and Nonresident Visitor Expenditures

The average expenditure per day in the Upper Missouri Basin for a nonresident was $191 in 1990 (Duffield et al. 1990). This amount is $286 in 2005 dollars. All of those expenditures are assumed to have been made in-state. The number of nonresident angler days on the proposed ORW reach of the Gallatin is estimated at 21,243 in 2003. The number of nonresident, nonfishing river visitor days per year is estimated at 20% of this total (using information in Duffield et al. 1990). Specifically, 21,243 nonresident angler days represents 83.2% of total nonresident, noncommercial river use. If 83.2% is nonresident angler use, then 16.8% is nonresident, non-angler (noncommercial use). Thus, the ratio of the two percentages (0.168/0.832) indicates that about 20% of the nonresident use of the river is non-angler use, or 4,248 visitor days. Adding these two numbers, total nonresident visitor days in 2003 is estimated at 25,491, leading to a total influx of out-of-state expenditures into Montana of $7.29 million ($286/day x 25,491 days = $7.29 million; in 2005 dollars) that would not have come into the

state without the resources in the Gallatin River. This estimate appears reasonable as the economic impact of angling use on the Gallatin River in 1995 was estimated at $5.9 million (Stroock 1997).

There are five commercial rafting companies that are licensed by the USDA Forest Service to run commercial trips down the Gallatin River. These trips cost about $45 for a half-day trip to $75 for a full-day trip. The gross revenues of commercial rafting were estimated at $750,000 in 1997, and are included in the non-angler recreation figure above (Stroock 1997).

The number of outfitters licensed to guide in the Gallatin River by the Montana Board of Outfitters has varied from 39 to 52 over the past six years (Johnston 2006). Each outfitter can sponsor several individual guides to lead fishing and hunting trips in the outfitter's licensed area. Table 3.5-6 summarizes the clients served by fishing outfitters along the Gallatin River from 1999 to 2005 (Johnston 2006). The proposed ORW reach of the Gallatin River is enclosed in the Gallatin National Forest, which would normally regulate fishing access by issuing permits for the Forest Service launch sites along a given waterbody; however, fishing from boats is not a permitted activity along the Gallatin River from the Yellowstone National Park boundary to the confluence with East Gallatin River (FWP 2006a). Therefore, the access points along U.S. Highway 191 and within campgrounds are essentially unregulated.

Table 3.5-6. Number of outfitters licensed to guide on the Gallatin River and the number of fishing clients served by year and resident status from 1999 to 2005 (Johnston 2006).

Year	**Number of outfitters licensed**	**Actual clients served [a]**		**Service days**	
		Nonresident	**Resident**	**Nonresident**	**Resident**
1999	39	---	---	1,939	41
2000	42	---	---	2,017	78
2001	42	---	---	1,626	408 [b]
2002	37	1,849	35	1,524	552[b]
2003	40	1,408	55	1,528	55
2004	52	2,220	37	2,327	41
2005	45	2,038	42	2,149	49

[a] This statistic was not reported prior to 2002.
[b] 361 and 525 of these days were accumulated by a single outfitter in 2001 and 2002, respectively.

Translating Visitor Expenditures into Job Estimates

Expenditures by nonresidents visiting the Gallatin River support jobs in Gallatin County. Most of the direct jobs that are supported by the proposed ORW reach of the Gallatin River are service jobs in restaurants, hotels, sporting goods stores, etc.; however, the multiplier effects (dollars circulating and re-circulating through the economy) result in employment in indirect inter-industry sectors that support the tourism sectors. There is often an induced effect of river-supported employees (people employed in Gallatin County) spending their wages locally, on other sectors of the economy totally unrelated to tourism (e.g., dental care, home furnishings, etc.).

The approximate total jobs supported by recreation in the study area was estimated by multiplying out-of-state visitor expenditures by the regional multipliers for Montana from the Bureau of Economic Analysis' Regional Input-Output Modeling System (U.S. Bureau of

Economic Analysis 1986). Since Duffield et al. (1990) do not separate nonresident spending by economic sector (e.g., hotels, restaurants, etc.); the sectoral breakdown provided for nonresident stream anglers in Montana was taken from Duffield et al. (1987). The sectoral multipliers yield a weighted average employment multiplier coefficient that can be applied to the $7.29 million of nonresident spending to calculate that 438 jobs are associated with nonresident river tourism spending on the proposed ORW reach of the Gallatin River. This estimate is comparable to previous estimates made in the mid-1990s, when recreation services were estimated to employ over 500 persons at an annual payroll of $5 million in the Gallatin Valley (Forrest 1997). The wages from these jobs generate local, state, and federal tax revenues that may not otherwise occur without the river.

Table 3.5-7 provides a summary of the economic effects associated with nonresident visitor expenditures on the Gallatin River.

Table 3.5-7. Summary of annual local economic effects of nonresident recreation use on the Gallatin River.

Resource	Specifics	Value	Description
Expenditures by out-of-state Gallatin River Visitors	25,491 nonresident days X $286 per day	$7,290,426	Out of state money spent in Montana by nonresident users
Jobs in local area directly tied to Gallatin River	Jobs in hotels, restaurants, sporting good shops, outfitters	438 jobs	Most jobs probably located in Big Sky, Bozeman, and nearby areas

3.5.3.8 The Net Economic Value of Fishing and other Recreation on the Gallatin River

While visitor spending on river activities generates a local economic gain to tourist industries, it represents a cost to the visitors themselves. The economic value retained by visitors, both Montana residents and out-of-state tourists, is the extra amount they would have paid, if necessary, to visit this particular recreation area. This extra amount of benefits received by the visitor is called net economic value, net willingness to pay, or consumer surplus (Loomis and Walsh 1997). For example, if it cost $50 for a fishing trip (e.g., for gas and food), but it was worth $80 to the visitor, the net economic value of the trip would be $30.

The U.S. Water Resources Council (1983) recommends agencies use one of two methods for estimating net economic value: (a) the travel cost method (TCM), which traces out a recreation demand curve based on trips taken and travel costs paid; or (b) the contingent valuation method (CVM) which directly asks visitors their net value. CVM interviews or questionnaires often ask visitors to pick a “ceiling cost” or an additional dollar amount that they would have been willing to pay to enjoy the same trip.

Net Economic Value of Fishing

In a report from Montana Fish, Wildlife and Parks, a net economic value was calculated for a fishing day on the Gallatin using the average value per fishing trip divided by the average number of days per trip (Duffield et al. 1987). The net economic value for a fishing day on the

Gallatin was calculated at $71 in 1987 dollars.[1] In 2005 dollars, this amount translates to $122. That is, the average person fishing the Gallatin River values a day of fishing at $122 above what the actual expenditure was for the day. This number is used to determine net economic value of fishing on the proposed ORW reach of the Gallatin River.

Multiplying the total annual fishing days on the Gallatin River (31,485), by the estimated net economic fishing value per day for the Gallatin River (at $122), yields a total of about $3,841,170 in current annual net economic value for the proposed ORW reach of Gallatin River for fishing. This dollar amount is the estimated value to anglers each year of fishing the stretch of Gallatin above what they pay for the trip, not the amount of economic value generated by the proposed ORW reach.

Net Economic Value of Other Water-Based Recreation Use on the Gallatin River

Using the ratios of non-angler use from the Duffield et al. (1990) report for the Gallatin River, the number of non-angler, noncommercial boaters is estimated to be 13,078. A broad-based mail survey conducted for Montana Department of Natural Resources and Conservation in 1989 by Duffield et al. (1990) for the entire Missouri River Basin was used to obtain net economic values. The study found that the Montana resident value per day of a recreational trip (for any recreational purpose) in the Upper Missouri River subbasin, including the Gallatin River, was $53 in 1989 dollars and $83.80 in 2005 dollars.[2] Since the majority of the non-angling use is by residents, this value is used as the overall estimate of the net economic value of non-angler river use on the Gallatin River. Using $83.80 for a recreational day of any kind on the Gallatin River, the net economic value for other non-angling, noncommercial recreation days on the river is estimated at $1,095,936. Again, this is the estimated value to boaters each year of rafting within the proposed ORW reach of the Gallatin River above what they actually pay for the trip, not the amount of economic value generated by the proposed ORW reach.

Net Economic Value of Commercial River Rafting

Forrest (1997) indicates that the number of commercial rafting days in 1997 was 20,000. The majority of floaters interviewed on the river in the user survey were from outside Montana (Forrest 1997). To provide an estimate of the net economic value associated with commercial rafting, the Duffield et al. (1990) estimate was used for the value of nonresident river recreation of $193 in 1989 dollars, or $305 in 2005 dollars. Since this amount is an average of nonresident anglers and rafters, to be conservative, the commercial rafting fee of $75 for a day trip was subtracted to ensure that the estimate is of net value or consumer surplus. Thus, the net economic value of rafting to the visitors themselves is estimated to be $230 per day. Multiplying this amount by the estimated 20,000 commercial rafting days yields a net economic value of $4.6 million annually.

[1] This fishing survey was conducted in the fall of 1987. Thus, these numbers must be updated to 2005 levels using the consumer price index (CPI) found at http://www.bls.gov/. Using 1987 as a reference base date and 2005 as an endpoint date, a CPI for all items using a western U.S. city average went from 114.3 in 1987 to 197 in 2005.

[2] The Recreation survey was conducted in the fall of 1989. Thus, these numbers must be updated to 2005 levels using the consumer price index (CPI) found at http://www.bls.gov/. Using 1989 as a reference base date and 2005 as an endpoint date, a CPI for all items using a western U.S. city average went from 124.6 in 1989 to 197 in 2005.

Summary of On-Site Recreation Use Values

Table 3.5-8 below provides a summary of the fishing, rafting, and other river-related recreation use values associated with the Gallatin River. As this table indicates, the values are substantial, and nonresident visitors make more than $7 million in expenditures annually. These nonresident expenditures support more than 400 jobs related directly and indirectly to nonresident tourism along the Gallatin River. The river also provides nearly $10 million in economic value to resident and nonresident visitors above and beyond their expenditures.

Table 3.5-8. Summary of annual net economic value of on site recreation use on the Gallatin River.

Resource	Specifics	Value	Description
Net Economic Value of Fishing to Anglers on the Gallatin River	31,485 annual fishing days X $122 value per day	$3,841,170	Blue Ribbon Fishery
Net Economic Value of other Recreation on the Gallatin River	13,078 annual non-fishing recreation days X $83.80 per day	$1,095,936	Exceptional whitewater rafting, kayaking, hiking, horseback riding, wildlife viewing
Net Economic Value of Commercial Rafting	20,000 commercial rafting days x $230 per day	$4,600,000	Value to visitors from commercial rafting on the Gallatin River

3.5.3.9 The Value of Water Quality to Residential Property Owners and Residents of Montana

The Value of Water Quality to Residential Property Owners

Maintaining the currently high water quality of the Gallatin River has a direct economic value to people who own property along or nearby the river. Specifically, people who own houses bordering and within a short distance of the river (e.g., 700 feet [Epp and Al-Ani 1979]) derive aesthetic benefits from water quality. This is a type of use value that would be capitalized into the property or house price (Epp and Al-Ani 1979, Boyle and Taylor 2001). Evaluating differences in house prices on streams or lakes with good water quality and those with less desirable water quality, holding other house characteristics constant, provides an estimate of the value or willingness of property owners to pay for water quality. Statistically, such a comparison is done using the hedonic property method (HPM—see Boyle and Taylor 2001). Hedonic evaluation assesses the effect that the quality of an item has on its price or on a consumer's willingness to pay.

Rather than conducting an original hedonic property study, a review of the existing literature was performed. The use of existing studies to provide insights about the value of an unstudied resource is called benefit transfer (Rosenberger and Loomis 2001) and is routinely done by a wide range of agencies including the U.S. Forest Service and U.S. Environmental Protection Agency.

A review of several electronic databases did not turn up any Montana-specific hedonic property studies with respect to water quality; however, there have been several studies that show a statistically significant effect of river water quality (Epp and Al-Ani 1979) and lake water quality on house prices (Steinnes 1992, d'Arge and Shogren 1989, Boyle and Taylor 2001). The water

quality measure most frequently used was water clarity, but pH and homeowner's perception of water quality were also analyzed. Two studies compared house prices at rivers with good and poor water quality (Epp and Al-Ani 1979) and lakes with good and poor water quality (d'Arge and Shogren 1989). The d'Arge and Shogren study allows calculation of the percentage difference in house price associated with the water quality differential. Across the methods used, including hedonic analysis and interviews with realtors, house prices were 20% lower at the lake with poor water quality as compared to identical houses with good water quality. In a study of lakes in Maine, Boyle and Taylor found that lake water clarity contributed between 3% and 9% to property values (with a mean of 6.4%). While there are several obvious differences between these studies and the Gallatin River in terms of location and type of water studied, the studies provide some empirical evidence that water quality matters to house prices, and the relative magnitude of influence of water quality on house prices. The use of existing benefit studies to provide some insight regarding the benefits elsewhere is known as "benefit transfer" and is widely practiced by many federal agencies (see Rosenberger and Loomis 2001).

Empirical Estimates of Non-Use or Passive Use Values Associated with Maintaining Water Quality

Some people who may not currently visit the Gallatin River still may derive benefits from maintaining water quality of the river. These non-use, or passive use or preservation, benefits are often categorized as: (a) an option value to visit a river with good water quality in the future; (b) an existence value obtained from knowing water quality is protected for its own sake or for non-game species; or (c) a bequest value from knowing that river protection today will maintain water quality for future generations (Greenley et al. 1981).

Quantification of these values requires a constructed or simulated market, since the values cannot be bought and sold in markets, nor are they limited to current visitors. Simulated markets are constructed to allow households to purchase a specific increase in water quality at some form of higher taxes or water bills (Greenley et al. 1981, Sutherland and Walsh 1985). A review of water quality studies by Fisher and Raucher (1984) indicated that about half the benefits of protecting water quality accrue to non-users in the form of these option, existence, and bequest values, or collectively what is called "passive use value."

Various studies over the years have demonstrated that households will pay higher taxes to protect water quality even if they do not currently use that water for drinking or recreation (see Fisher and Raucher, 1984 for a summary of the early literature). One of the first such studies was the value of improving water quality on the South Platte River near Denver, Colorado (Greenley et al. 1981). More recently, Mathews et al. (1999) found that Minnesota households would pay additional taxes between $14 and $20 per year for a 40% reduction in phosphorus in the Minnesota River.

While several studies have asked Montana residents their willingness to pay for increasing instream flows (Duffield et al. 1990), only one study has estimated Montana residents' willingness to pay for maintaining water quality for a water body in Montana. That study was a contingent valuation study of what Montana households would pay to protect water quality of the Flathead River and Flathead Lake (Sutherland and Walsh 1985). Montana residents were asked to write down in the mail survey the maximum amount they would pay each year to protect

water quality of Flathead Lake and the Flathead River. The mean annual willingness to pay (WTP) was $64 in 1981 dollars, or $137 in 2005 dollars. The percentage that respondents indicated was for recreation use was 11% for the current year and 17% for the option to visit in the future. The largest percentage benefit was for bequest value at 41% and existence value at 31%. Montana residents place a substantial passive use value on maintaining water quality, as it represents 89% of their total value in the Sutherland and Walsh (1985) study.

While the Gallatin River may not be quite as substantial a water resource as Flathead Lake and the Flathead River, the proportions of total value associated with option, existence, and bequest may apply. In addition, the Sutherland and Walsh (1985) study allows investigation of how the value of water quality might change with the distance of a household from the Gallatin River. The results of Sutherland and Walsh's empirical analysis of the relationship between option, existence, and bequest value and distance from the water body, suggest these values fall off fairly slowly with distance. In particular, they found that annual option value falls at a rate of about 1.5 cents per mile, while annual existence and annual bequest value falls at a rate of 5.4 cents and 6.3 cents per mile, respectively. Thus, households 100 miles away from the Gallatin River would only have the willingness to pay for option, existence, and bequest values reduced by $1.50, $5.40, and $6.30, respectively. This suggests that there would be substantial benefits in the major population centers of western Montana from maintaining water quality in the Gallatin River.

3.5.3.9 Anticipated Costs Associated with ORW Designation

Criteria for Determining Affected Land

The ORW designation would primarily affect point sources, or other sources approved by DEQ that have a direct hydrologic connection to the proposed ORW reach of the mainstem of the Gallatin River. Elsewhere in this EIS, the details of the zone of influence, or footprint, are presented, and in Section 3.4 (Land Use and Recreation), the number of parcels affected is calculated based on those inside the footprint, outside of an existing sewer system, and not yet with an approved subdivision plan.

Many of these parcels would typically be allowed to put in an approved septic system with a leach/drainfield as long as they would not exceed DEQ trigger values for phosphorus and nitrogen, as evaluated through nondegradation analysis. Within current laws and regulations, if the proposed septic system or point source from a parcel exceeds these trigger values and exceeds the narrative limits, it could still be approved by DEQ, even if it permanently degraded water quality, as long as the degradation would not cause violation of the overall state water quality standard for the Gallatin River, and if it met the requirements stipulated in 75-5-303, MCA and ARM 17.30.706-708.

ORW designation would not allow permanent degradation of water quality. Thus, for parcels that are in proximity to the Gallatin River and have a direct hydrologic connection to the river, the ORW designation may limit the amount of phosphorus and nitrogen entering the river.

Such limitations may require individuals wishing to build within the footprint to adopt different and potentially more expensive approaches for disposing of their wastewater. As discussed more

in Chapter 4, these additional costs may add 1-3% to the cost of building a new home or commercial building, or limit residential and commercial development in the footprint. This could cause adverse economic impacts in the study area. Such effects are discussed further in Chapter 4.

3.6 Aquatic Life and Habitats

3.6.1 Overview

The proposed ORW reach of the Gallatin River flows north out of Yellowstone National Park through the high altitude, narrow Gallatin Canyon. The steep-sided canyon restricts the amount of sunlight that reaches the river channel, maintaining cool river temperatures in the summer and intensifying harsh winter conditions. Sections of the proposed ORW reach freeze during winter, reducing primary productivity (aquatic vegetation growth). Areas of groundwater and thermal spring upwelling in the upper part of the reach may mitigate winter conditions. The cold climate, steep topography, and limited flat areas in the valley bottom restrict land uses found in other parts of Gallatin County, such as hay cultivation and livestock grazing. Consequently, the proposed ORW reach of the Gallatin River is unregulated by dams and diversions, and few areas are affected by livestock or agricultural impacts. Sources of human-caused pollution in the proposed ORW reach generally stem from development and associated infrastructure such as roads.

3.6.2 Inventory Methods

The study area for evaluating the aquatic habitat and aquatic life resources was defined as the area within the proposed ORW reach below the mean high water line for the mainstem of the Gallatin River. Montana Fish, Wildlife and Parks, U.S. Fish and Wildlife Service (USFWS), and the Gallatin National Forest fisheries biologists were consulted regarding fish populations and current fisheries management in this study area. Published literature was reviewed for information on the aquatic species present in the Gallatin River. Water quality data were reviewed to determine the effects of existing nutrient levels in the surface water on resident aquatic species. The USFWS was consulted regarding federally listed threatened, endangered, or candidate species in the study area, and a Montana Natural Heritage Program database search was conducted to determine known sensitive aquatic species present within one mile of the proposed ORW reach of the Gallatin River (since these species could reasonably be expected to migrate to the designated study area). Very little aquatic habitat information was available for the proposed ORW reach of the Gallatin River. Therefore, although the study area for aquatic resources focused on the mainstem of the Gallatin River, studies conducted in its major tributaries were also reviewed to provide information on the area's aquatic ecology.

3.6.3 Inventory Results

3.6.3.1 Aquatic Habitat

The physical habitat below the water line in the Gallatin River is governed by the speed of the water flow, the complexity of the riverbed materials, and the shape of the river channel. The mainstem of the Gallatin River is comprised of broad, meandering stream types flowing through a low gradient valley. The valley bottom varies from steep-sided and narrow, to broad and open. Riparian vegetation varies from evergreen forests extending to the waterline along rocky banks, to open fields that transition to grassy areas. The valley slope averages 1.0% and the stream slope averages 0.8% along the mainstem, while the sinuosity averages 1.13 (DEQ 2005b). Sinuosity is

a measure of how much the river channel meanders across the valley bottom. Rivers with lots of twists and turns have high sinuosity (> 1.5), while straight rivers have sinuosities approaching 1.0 (Armantrout 1998). Tributary channels in the Gallatin River watershed are generally much steeper, straighter, and narrower than the mainstem. U.S. Highway 191 encroaches on the mainstem in several areas, and the highway crosses the river three times and tributary channels four times within the proposed ORW reach (DOT and MDT 2005). Most tributaries extend into publicly owned lands, where road densities and numbers of stream crossings vary considerably.

To facilitate habitat analysis, the proposed ORW reach was divided into six subreaches based on the width of the valley bottom and the character of the resulting stream habitat. In the following subreach descriptions, the term “valley bottom” refers to the land at the base of the mountain slopes, while “river channel” refers to the area below the mean high water line.

The moderately confined to unconfined valley bottom extending from the Yellowstone National Park boundary near Teepee Creek downstream to the Cinnamon Creek confluence has well defined, grassy banks with extensive undercut sections. These undercut banks provide aquatic organisms shade and shelter in an otherwise open channel. The channel substrate is mostly cobble and gravels with some fine sediments. The highway crosses the Gallatin River approximately one mile downstream of Teepee Creek.

As the valley narrows downstream of Cinnamon Creek, the river becomes naturally confined by steep mountainsides, and the riverbed shifts to a straight, broad channel until the confluence with Elkhorn Creek. Smaller substrate is replaced by larger cobble and boulder with occasional large woody material from downed trees increasing aquatic habitat complexity. Downstream of the Elkhorn Creek confluence the valley opens up gradually, leading to more meanders until just downstream of the confluence with the West Fork of the Gallatin River, where the river passes under U.S. Highway 191 at the Jack Smith Bridge near river mile (RM) 67.8.

From the Jack Smith Bridge to the confluence with Moose Creek, the valley alternates constricted areas with brief valley bottom openings, but the river channel is confined by the steep banks. The reach from Moose Creek to Storm Castle Creek has an increased gradient and is much narrower and faster flowing than the upper subreaches. Large boulders in this reach provide refuge to aquatic organisms from the fast-flowing water. Downstream from Storm Castle Creek to the confluence with Spanish Creek, the river valley opens up again, but the river channel is incised (deeply cut into the substrate) and remains confined by the resulting steep, rocky banks. Substrate in this reach is predominantly larger boulders and cobble.

Water quality in the mainstem of the Gallatin River is generally very good with respect to nitrate and phosphorus concentrations (BWTF 2005) (See also Section 3.3.3.1). Nitrate levels are well below the EPA drinking water criteria of 10 mg/L. However, nitrates can be toxic to aquatic macroinvertebrates and fish at considerably lower levels. Nitrate toxicity to aquatic animals occurs when oxygen-carrying pigments in the blood and body fluids such as hemoglobin are converted to forms that are incapable of carrying oxygen (Carmago et al. 2005). Nitrate toxicity increases with concentration and exposure time; therefore, although short pulses of even moderate levels of nitrate may not cause mortality, consistent exposure to low levels can adversely affect sensitive aquatic macroinvertebrates and fish (Carmago et al. 2005). Effects can

vary from reduced reproductive success, decreased coordination (which can lead to lower survival rates) and death. Although amphibians appear to be less susceptible to nitrate toxicity, especially in their adult phase, studies have demonstrated toxicity at levels below the EPA drinking water criteria of 10 mg/L (Baker and Waights 1993). These studies suggest that the state numeric water quality criterion, which uses the EPA drinking water standard, for nitrate may not be protective of aquatic life (DEQ 2006a).

3.6.3.2 Benthic Macroinvertebrates

Benthic macroinvertebrates are the visible organisms (insect larvae, worms, clams, etc.) that live on stream and lake bottoms. They are widely used in ecological studies to provide a biological measure of ecosystem health and water quality. Benthic macroinvertebrates are abundant and diverse, providing a wealth of information when sampled and enumerated. Some are long-lived (more than one year), and thus their presence or absence can provide information on whether serious environmental perturbations have occurred in the past year. Because some categories of benthic macroinvertebrates are more sensitive (such as mayflies) and other types are less sensitive (such as midges), the proportions of these groups living in a stream bed can be taken as an index of water quality. A stream with a higher percentage of mayflies may be considered to have better quality water than a stream with a high number of midges. Measures such as these, used across a wide range of groups (mayflies, stoneflies, caddisflies, filter feeders versus scrapers, etc.), are combined into a multimetric index. Such an index provides an overall score for water quality and can thus be compared across years or across sites in relatively similar habitats. Details of multimetric indices and their use with benthic macroinvertebrates and water quality are provided in Karr and Chu (1999).

Sampling of benthic macroinvertebrates was undertaken in the proposed ORW reach and at one site in the West Fork of the Gallatin River in four years spanning a five-year period (2001, 2002, 2003, and 2005). Sampling was conducted by members of the Blue Water Task Force in Big Sky, Montana, and analyzed by Rhithron Associates, Inc., of Missoula, Montana. Kick sampling, whereby macroinvertebrates are dislodged from substrate and collected in a net, was conducted in a standard method approved by DEQ (Bukantis 1998). Samples were collected at three sites in the Gallatin River (below the Taylor Creek confluence, below the Dudley Creek confluence, and below the Porcupine Creek trailhead), and results were provided in a series of reports (Bollman 2002, 2003, and 2005).

Results from 2005 showed a decline in water quality, from unimpaired in 2002 and 2003, to slightly impaired at all sites in 2005. (Metrics from 2002 also showed overall a slight impairment in water quality.) This decline, from 2002/2003 to 2005, in apparent water quality was shown by an increase in organisms more tolerant of impaired water; for example, the proportion of midges increased in 2005. The author (Bollman 2005) speculates that this decrease in water quality from unimpaired to slightly impaired might have been due to drought, low flow, and higher water temperatures in the mainstem Gallatin River; however, no flow level or water temperature data were provided; thus the reason for the decline in water quality, as measured in the benthic macroinvertebrate community, is not known.

3.6.3.3 Benthic Algae

In 1998 and 2000, twelve samples were taken of periphyton (algae and microorganisms attached to the bottom of freshwater streams) in the mainstem Gallatin River in the proposed ORW reach, and five samples were taken in tributaries to the proposed ORW reach (Bahls 2001). These samples were taken to assess water quality and to decide whether any TMDLs were needed in the watershed. Algae were collected according to standard operating procedures of the DEQ Planning, Prevention, and Assistance Division (Bahls 2001). Algal communities were evaluated using a modified version of EPA rapid bioassessment protocols for wadeable streams.

Periphyton provides a good measure of aquatic ecosystem health because it is diverse in species and present in ample amounts to sufficiently sample. It is relatively quick, easy, and inexpensive to sample and integrates the effects of different environmental stressors, providing a measure of their aggregate impacts (Bahls 2001).

Overall, the algal and diatom assemblages showed good water quality, with some nutrient enrichment. The analysis also showed nitrogen as the limiting nutrient in the mainstem Gallatin River. Sedimentation, the accumulation of fine sediments along the bottom, caused at least minor water quality impairment at all sites in both years, and, in 1998, it caused moderate impairment from sedimentation at two sites: one above, and one just below the confluence with the West Fork of the Gallatin River. Excess fine sediments can clog gills of macroinvertebrates and fish and reduce their respiratory capacity. In general, the algal community in the mainstem Gallatin River differed above and below the confluence with the West Fork, with a higher proportion of pollution-sensitive algae and diatoms above the confluence than below. This result indicates that nutrients and organic matter are probably being released into the mainstem Gallatin River by the West Fork (Bahls 2001).

3.7 Fisheries

3.7.1 Overview

The study area for evaluating fisheries resources and habitat was defined as the area below the mean high water line for the mainstem of the Gallatin River within the proposed ORW reach. Discussion of the fisheries within major tributaries is included, when available, since fish species with migratory life history components in the proposed ORW reach of the Gallatin River may spend extended periods in the tributaries.

The Gallatin River is considered one of America's "blue-ribbon" trout fisheries. The Gallatin National Forest Forest Plan EIS classifies fishing on the Gallatin National Forest as being of national interest and states that the Gallatin, Madison, and Yellowstone rivers are all "blue ribbon" trout streams of national significance (USDA Forest Service 1987).

As mentioned in the aquatic habitat section (Section 3.6.1), winter conditions in the Gallatin River can be extremely cold and primary productivity can be limited when sections of the river freeze. It is the severe winter conditions that regulate fish populations (Byorth and Weiss 2003). Trout tend to grow more slowly in the Gallatin than in other Montana rivers, in part because of the cold winter conditions. An age 3 rainbow trout will average 8.9 inches long (fork length) in the Porcupine section of the Gallatin River and 10.7 inches in the East Gallatin River, which has much warmer stream temperatures year-round (Byorth and Weiss 2003). However, the Gallatin River's cold water protects the fishery in summer by reducing the spread of some water-borne diseases, such as whirling disease (Kerans et al. 2005).

3.7.2 Inventory Methods

State-maintained databases and web pages, including the Montana Natural Heritage Program, the Montana Fisheries Information System (MFISH), and the Montana Fish, Wildlife and Parks on-line fishing guide (FWP 2006a), were searched for fisheries information. The USFWS was consulted regarding federally listed threatened, endangered, or candidate species in the study area. In addition, a Montana Natural Heritage Program database search was conducted to determine known sensitive aquatic species present within one mile of the proposed ORW reach of the Gallatin River (since these species could reasonably be expected to migrate to the designated study area). Literature on the Gallatin River fishery is limited, but the Gallatin River watershed has been the site of several theses and biological studies.

3.7.3 Inventory Results

3.7.3.1 Fish Populations

Since the 1980s, Montana Fish, Wildlife and Parks has monitored Gallatin River fish populations using electrofishing (Byorth and Weiss 2003). Trout are the focus of this monitoring effort, because they are the targets of angling. Montana Fish, Wildlife and Parks established two monitoring sections within the proposed ORW reach, each approximately two miles long: the Porcupine section upstream of the West Fork of the Gallatin River confluence, and the Jack Smith section, just downstream of the Jack Smith Bridge. Monitoring occurs approximately

every other year in the late summer or early fall. Fish species documented in the proposed ORW reach are listed in Table 3.7-1.

Table 3.7-1. Fish species present in the proposed ORW reach of the Gallatin River (FWP 2006b).

Common name	**Scientific name**	**Abundance**	**Native or introduced**
Arctic grayling	*Thymallus arcticus*	Rare	Stocked by FWP [a]
Brook trout	*Salvelinus fontinalis*	Rare	Introduced
Brown trout	*Salmo trutta*	Common/rare[b]	Introduced
Rainbow trout	*Oncorhynchus mykiss*	Abundant	Introduced
Yellowstone cutthroat trout	*Oncorhynchus clarki bouvieri*	Rare	Native
Mountain whitefish	*Prosopium williamsoni*	Common	Native
Longnose dace	*Rhinichthys cataractae*	Rare	Native
Longnose sucker	*Catostomus catostomus*	Common	Native
Mountain sucker	*Catostomus platyrhynchus*	Rare	Native
White sucker	*Catostomus commersoni*	Common	Native
Mottled sculpin	*Cottus bairdi*	Common	Native

[a] Montana Fish, Wildlife and Parks began stocking Arctic grayling into the Gallatin River in 1992, and has stocked them annually since 2002 (FWP 2006b).
[b]Common in lower reaches, but rare in colder, upstream areas.

Rainbow trout predominate in the proposed ORW reach, while brown trout are limited (Byorth and Weiss 2003). Populations for both species are stable and patterns in fish abundance and species composition are apparent. The Porcupine section tends to have fewer fish per mile than the Jack Smith section, but brown trout numbers are higher in the Porcupine section (Tohtz 2005a, Byorth and Weiss 2003) (Figure 3.7-1). To date, numbers of brown trout captured in the Jack Smith section have been too low to generate a population estimate, while population estimates for brown trout in the Porcupine section have been made since 1998 (Tohtz 2005a).

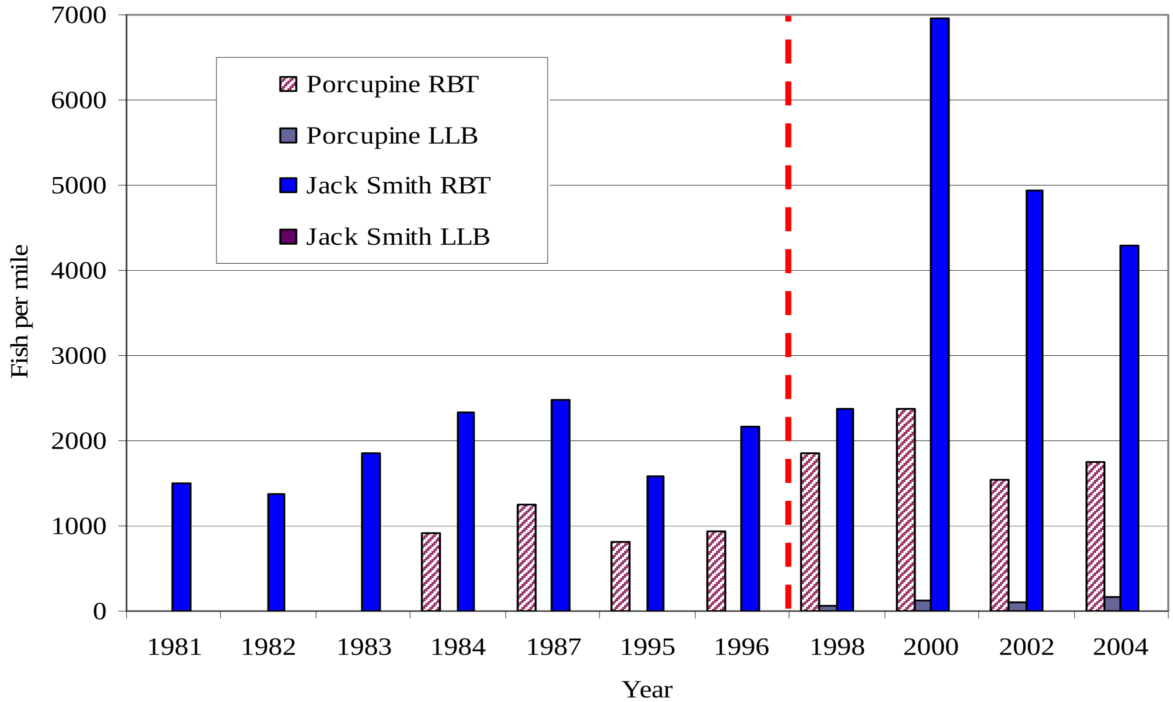

Figure 3.7-1. Trout population estimates for rainbow (RBT) and brown (LLB) trout in the Porcupine and Jack Smith sections of the Gallatin River from 1981 to 2004 (Tohtz 2005a, Byorth and Weiss 2003). Estimates are for fish six inches or longer (total length (TL)). No estimates are available for the Porcupine section for 1981-1983. Estimates prior to 1998 (left of dashed line) were made with a different estimator and may not be as reliable as estimates made after 1998.

Although Yellowstone cutthroat trout occur in the proposed ORW reach, the number captured in the monitoring sections is not large enough to generate a population estimate. Westslope cutthroat trout occasionally stray out of the tributaries they occupy in the Gallatin River watershed, but are not considered residents in the mainstem Gallatin River (J. Tohtz, pers. comm. 2006). Yellowstone cutthroat trout and westslope cutthroat trout are state species of concern and are discussed below. Both species of cutthroat trout are managed as “catch and release” only throughout the state, except in special management areas (FWP 2006c). Rainbow and brown trout are the primary game species in the proposed ORW reach of the Gallatin River.

Rainbow Trout

The rainbow trout is Montana's number one game fish. Beginning in 1889, they were introduced from numerous hatchery stocks into virtually every suitable habitat in the state (FWP 2006d). Through hybridization and competition, rainbow trout introductions have caused a severe reduction in the range of the native cutthroat trout. Rainbow trout fare well under a wide range of habitat conditions from ponds to reservoirs, lakes, and streams. Today, rainbow trout are stocked primarily in lakes and reservoirs, but no longer in streams (FWP 2006d). They are efficient at feeding opportunistically on plankton, aquatic and terrestrial insects, and occasionally smaller fishes, tailoring their diet to what is available. Rainbow trout spawn in gravel nests called redds in early spring in flowing water, usually April or May, and maintain healthy populations if the habitat is not degraded (FWP 2006d).

Brown Trout

The brown trout belongs to a different genus (*Salmo*) than Montana's native trout (*Oncorhynchus*) species. Brown trout evolved in Europe and western Asia and were introduced to North America in 1883 and to Montana in 1889 in the Madison River (FWP 2006e). Today brown trout are found throughout most of Montana. Generally, they prefer lower gradient, larger streams than cutthroat and rainbow trout and do well in many reservoirs. Brown trout were widely stocked in the first half of this century, but today most come from natural reproduction (FWP 2006e). They are great competitors and generally more tolerant of dewatering and other environmental disturbances than other trout species. Brown trout also spawn in redds, but their spawning season is in the fall. This fall spawning gives them a distinct advantage in some human-influenced habitats since their spawning and incubation period lies outside the irrigation season (FWP 2006e); however, in the Gallatin River, this exposes their incubating eggs to the coldest period and lowest stream flows of the year. The cold water temperature is the most likely limiting factor for brown trout populations in the mainstem of the Gallatin River. Brown trout are more predaceous than rainbow or cutthroat trout, and large fish often feed at night on other fish, as well as on crayfish and other invertebrates.

3.7.3.2 Species of Concern

The Montana Natural Heritage Program has records for two fish species of concern within one mile of the proposed ORW reach: westslope cutthroat and Yellowstone cutthroat trout (MNHP 2006a) (Table 3.7-2). Species of concern are managed more actively by Montana Fish, Wildlife and Parks, but this status does not provide legal protection to the species. In addition, Arctic grayling were introduced to the proposed ORW reach of the Gallatin River in 1992 and 1993, as part of an experimental reintroduction (J. Magee, pers. comm. 2006). Montana Fish, Wildlife and Parks has not found any evidence that these fish have established a self-sustaining population (J. Magee, pers. comm. 2006). Grayling have also been stocked downstream of the proposed ORW reach as part of a restoration effort led by the Arctic Grayling Workgroup (J. Magee, pers. comm. 2006). The Arctic Grayling Workgroup is composed of federal and state biologists and members of the research and local community and has been working to preserve and enhance Arctic grayling populations in Montana since 1991 (AGW 2005). Arctic grayling are currently listed as a candidate species under the federal Endangered Species Act.

Table 3.7-2. Aquatic species of concern documented or possibly present within 1 mile of the proposed ORW reach

Species	State and Federal Status[b]	Expected Occurrence	
		Mainstem	Tributaries
Westslope cutthroat trout [a]	S2	Extremely rare	Locally common
Yellowstone cutthroat trout [a]	S2	Rare	Locally common
Arctic grayling	S2, FC	Rare	Absent

[a] Montana Natural Heritage Program database search results. January 4, 2006.
[b]Key to status:
S2 At risk because of very limited and potentially declining numbers, extent and/or habitat, making it vulnerable to global extinction or extirpation in the state.
FC Federal Candidate species for listing under the Endangered Species Act

Westslope Cutthroat Trout

The westslope cutthroat trout is one of two subspecies of native cutthroat found in Montana. Together with the Yellowstone cutthroat, the two subspecies have been designated Montana's state fish (FWP 2006f). The westslope cutthroat's historic range was all of Montana west of the Continental Divide, as well as the upper Missouri River drainage east of the Continental Divide (FWP 2006f). This fish has been seriously reduced in range by two factors: hybridization with rainbow and/or Yellowstone cutthroat, and habitat loss and degradation. Pure westslope cutthroat have been identified by genetic analysis and form the broodstock maintained by the Montana Fish, Wildlife and Parks at its Anaconda hatchery (FWP 2006f). Cutthroat spawn in the spring in flowing water, burying their eggs in gravel redds, in riffles and pool crests. Spawning and rearing streams tend to be cold and nutrient poor. Cutthroat trout species have long been regarded as sensitive to fine sediment (generally defined as 6.3 millimeters or less) (FWP 2006f). Westslope cutthroat trout have three possible life history forms: adfluvial (live in lakes and migrate into streams to spawn), fluvial (live in the mainstem of rivers and migrate to streams to spawn), or resident (live and spawn in tributary streams). The westslope cutthroat trout in the Gallatin River watershed appear to be resident fish and spend their entire life in tributary streams (J. Tohtz, pers. comm. 2006). The Taylor Fork basin contains one of the few remaining populations of westslope cutthroat trout in the Gallatin River watershed (Shepard et al. 2003, Magee et al. 1996).

Yellowstone Cutthroat Trout

The Yellowstone cutthroat trout, as the name implies, is native to the Yellowstone River drainage of southwest and south-central Montana. Originally, their range extended as far downstream as the confluence of the Yellowstone River with the Tongue River; but, today, pure, unhybridized populations are limited to a few headwater streams and Yellowstone National Park (FWP 2006c). In general, Yellowstone cutthroat are larger than westslope cutthroat and more prone to eat fish as part of their diet.

Yellowstone cutthroat trout exhibit the same three primary life history patterns as westslope cutthroat trout: resident, fluvial, and adfluvial (FWP 2006c). Yellowstone cutthroat trout typically spawn in spring and early summer after flows have declined from their seasonal peak, and they tend to select sites for their redds with suitable substrate, water depth, and water velocity (Varley and Gresswell 1988). After emergence, fry immediately begin feeding, typically in nearby stream margin habitats, but they may also undertake migrations to other waters (Gresswell 1995).

Arctic Grayling

The Arctic grayling is native to northern North America. The only populations native to the lower 48 states occurred in Michigan and Montana, and the Michigan population is now extinct (FWP 2006g). Arctic grayling exhibit two life history forms: fluvial and lacustrine. The lacustrine form lives and spawns in lakes, while the fluvial form lives and spawns in rivers. Originally, the fluvial Arctic grayling was widespread throughout the upper Missouri River drainage as far downstream as Great Falls, Montana. Lewis and Clark made note of these "new kind of white or silvery trout" in 1805 (FWP 2006g). The lake-dwelling (lacustrine) form is fairly common in 30 or more lakes across the western half of Montana. Arctic grayling are spring spawners and broadcast their eggs over a gravel bottom in moving streams (i.e., they do not

construct redds, as do the cutthroat). The native population of fluvial Arctic grayling is now limited to the Big Hole River and is concentrated near the town of Wisdom, Montana. The Arctic grayling present in the proposed ORW reach of the Gallatin River were introduced in 1992 in an attempt to expand the species' presence to suitable waters identified by the Arctic Grayling Workgroup (AGW 2005).

3.7.3.3 Threatened and Endangered Species

The fluvial Arctic grayling is a candidate for listing under the Endangered Species Act. There are no other aquatic species that inhabit the proposed ORW reach of the Gallatin River that are listed, or proposed for listing, under the Endangered Species Act.

Arctic grayling were petitioned for federal listing in early 1991. The U.S. Fish and Wildlife Service found that the species' listing was "warranted but precluded" in 1994, meaning there is sufficient evidence to support listing, but listing is precluded by higher priorities (DOI 1994, USFWS 2005). Conservation efforts by the Arctic Grayling Workgroup were a major reason why listing was precluded (AGW 2005). The Arctic Grayling Workgroup is comprised of state and federal fisheries biologists, ranchers, and conservation group representatives. It was formed in 1989 in response to surveys in 1983 in the Big Hole River that identified declines in the Arctic grayling population (AGW 2005).

The warranted but precluded level of listing under the Endangered Species Act was replaced by "candidate" status in 1996 (USFWS 1996). In May 2003, the U.S. Fish and Wildlife Service was sued for continued candidate status and lack of action on fluvial Arctic grayling. In 2004, the Arctic grayling's candidate status was increased from a rating of nine to a three, the highest priority level for a candidate species (DOI 2004, USFWS 2005). Currently, the discussion on the status of Arctic grayling is based only on the fluvial component of the species. A lacustrine (lake-dwelling) component of the species exists in other areas of Montana, and these populations appear to be stable (FWP 2006g).

3.7.3.4 Recreational Fishery

The proposed ORW reach of the Gallatin River is recognized as a destination fishery for trout anglers. The quality of the fishery is often noted in advertising materials by the state, fly fishing outfitters, resort and hotel websites, and real estate brokers. The number of guides licensed to take clients on the Gallatin River has increased from the high 30s to the lower 50s in the past five years (See Table 3.5-6 in the Socioeconomics Section). Guided anglers are primarily nonresidents, but resident anglers are common along the proposed ORW reach. The Gallatin River is closed to fishing from boats from the Yellowstone National Park boundary to the confluence with the East Fork Gallatin River near Manhattan, Montana (FWP 2006a). Therefore, fishing is limited to wading and bank access within the proposed ORW reach. The mainstem of the Gallatin River is open to fishing year-round and is a destination for many out-of-state anglers.

As noted above, several species of salmonids are present in the proposed ORW reach (Table 3.7-1). Westslope cutthroat and Yellowstone cutthroat trout and Arctic grayling are catch-and-release only throughout Montana, except in certain reaches of the Yellowstone River (FWP 2006a). Montana Fish, Wildlife and Parks does not maintain any fishing access sites within the proposed

ORW reach, but several access points are available to anglers on Forest Service lands at campgrounds, pullouts, and picnic areas.

Montana Fish, Wildlife and Parks has not conducted a formal creel census on the Gallatin River since 1983; therefore, there is no current catch per unit of effort (catch rate) by which to judge the proposed ORW reach's recreational fishery (B. McFarland, pers. comm. 2006). However, the 2003 mail-in angler satisfaction survey ratings for the "salmonid stream" portion of the Gallatin River were 3.03 for residents and 2.97 for nonresidents, based on 347 and 424 respective responses (McFarland and Tarum 2003). This is consistent with the overall angler satisfaction ratings (3.00 for residents and 3.06 for nonresidents) for salmonid streams throughout Montana Fish, Wildlife and Parks' Region 3, which includes the Gallatin River (McFarland and Tarum 2003). Angler satisfaction is rated on a scale of one to five with five being "excellent" and one being "poor." Angling pressure in Region 3 accounted for nearly one-third (29%) of the state's total, with over 800,000 angler days in 2003 (McFarland and Tarum 2003). The Gallatin River accounted for over 100,000 of these days. Region 3 also has the highest number and percentage of nonresident anglers of Montana's seven fisheries management regions (McFarland and Tarum 2003).

3.8 Terrestrial Vegetation and Habitats

3.8.1 Overview

This section outlines the inventory methods used to gather published and unpublished data, and the synthesis of these data to provide descriptions of vegetative community types, noxious weed species, and species of concern. The study area is defined as the lands surrounding the proposed ORW reach of the Gallatin River from the Yellowstone National Park boundary downstream to the confluence with Spanish Creek. Although most of the discussion centers on the lands within the footprint developed around the proposed ORW reach, to describe the overall vegetative setting, some vegetation outside the proposed ORW footprint is described and clearly referred to as outside the ORW footprint.

3.8.2 Inventory Methods

To describe the vegetation in the ORW study area, an extensive literature search was performed focusing on vegetative communities and associated species, plant species of concern occurrences and associated habitat, noxious weed locations, habitat quality, and vegetation change in response to management actions. In December 2005 and January 2006, a literature search was conducted for vegetative descriptions of the study area using Web of Science, Agricola, and Biological Abstracts. Published (e.g., journal articles, books) and unpublished (e.g., government reports) documents were searched for in the University of Montana, Montana State University, and the Water Center libraries. Formal consultation was made with the Fish and Wildlife Service, Montana Fish, Wildlife and Parks, and the Montana Natural Heritage Program regarding species of concern in the project area. Biologists at Gallatin National Forest (GNF) Bozeman and Hebgen Lake Ranger Districts were contacted to obtain copies of relevant vegetation documents, maps, management plans, and GIS layers. The Gallatin County Weed District, Montana Department of Transportation, and the Northern Rocky Mountain Resource Conservation and Development (RC&D) offices, and large-scale landowners within the study area were contacted regarding noxious weed location data, maps, and GIS layers.

3.8.3 Inventory Results

Adequate information on vegetation resources was found for this study. Major sources of information were obtained from the Montana Natural Heritage Program, GNF, the Northern Rocky Mountain RC&D, and publications on the Montana Gap Analysis Project (GAP).

The vegetation information is separated into sections according to vegetation community types, noxious weeds, and species of concern. Vegetative communities describe the general vegetation distribution and associated over-story and under-story species. Noxious weeds include species present in the study area and their general locations. Species of concern within ten miles of the Gallatin River study area footprint are discussed. The scientific names provided in the text are the current nomenclature, as provided by the USDA Natural Resources Conservation Service (NRCS) Plant database (USDA NRCS 2006). A table of all plant species, with both scientific and common names, is provided in Appendix B.

3.8.3.1 Vegetation Community Types

The vegetation community types in the study area consist of coniferous forests, grasslands, shrublands, and riparian communities (USDA Forest Service 2005c, Redmond et al. 1998). Community types described below were defined and named by Redmond et al. (1998) as part of a land cover classification system for Montana GAP. Montana GAP distinguishes vegetation community types by dominant vegetation, floristic composition, environmental conditions, and the structural features of plants that can be delineated and distinguished from Landsat Thematic Mapper imagery. Coniferous vegetative community types in the ORW study area include Douglas-fir Forest, Lodgepole Pine Forest, Mixed Douglas-fir and Lodgepole Pine Forest, Mixed Whitebark Pine Forest, and Mixed Subalpine Forest. The dominant grassland vegetative community type is the Low and Moderate Cover Dry Grassland. Sagebrush Shrubland is the dominant shrub community type occurring in the uplands. Riparian community types include the Mixed Broadleaf and Conifer Riparian, Shrub Riparian, Graminoid and Forb Riparian, and Mixed Riparian vegetation types. Common associated species of these vegetative community types are provided in Table 3.8-1. Approximate locations described below are derived primarily from work by Redmond et al. (1998) and the USDA Forest Service (2005c).

Coniferous vegetative community types dominate the vegetation of the National Forest System lands in and directly adjacent to the ORW study area footprint. These coniferous communities extend from the proposed Gallatin River ORW to mountain ridges. The Douglas-fir Forest is most prominent in the lower elevation north end of the ORW study area. Lodgepole Pine, Mixed Douglas-fir and Lodgepole Pine, Mixed Whitebark Pine, and Mixed Subalpine Forest community types are the prominent coniferous community types in the mid- and southern portions of the ORW study area, and outside the proposed ORW at higher elevations.

Upland, non-coniferous community types within the proposed ORW footprint include Low and Moderate Cover Dry Grassland and Sagebrush Shrubland. Low and Moderate Cover Dry Grassland community type occupies the wider valleys and foothills near Spanish Creek, Big Sky, Porcupine Creek, and Taylor Creek. The majority of the private land in the study area occurs in this community type, where it is often used for urban development or grazing. The state- and federally-owned lands containing this community type are important habitat for ungulates such as deer and elk. The Sagebrush Shrubland community type is scattered throughout the study area. This community type is sparse in the northern portion of the study area but increases in abundance in the mid- and southern stretches of the study area, particularly near Big Sky, Taylor Creek, and Teepee Creek, where it can dominate open hillsides (Ripple and Beschta 2004).

Riparian communities occupy land adjacent to the Gallatin River and its tributaries. The majority of the ORW study area footprint has a narrow ribbon of riparian vegetation, or no riparian vegetation, due to the steep mountain slopes that abut the river’s edge. Where the valleys are wider, riparian zones extend further from the active water channel. Mixed Broadleaf and Conifer Riparian is present in small isolated patches, primarily in the northern half of the study area. The Graminoid and Forb Riparian community type is predominantly found in the valley of Spanish Creek. Shrub Riparian and Mixed Riparian community types are scattered throughout the northern half of the ORW study area. These two types become more dominant along the Gallatin River near Big Sky. In the southern end of the study area, Shrub Riparian and Mixed Riparian communities become a major component of the vegetation within the footprint, particularly

along Taylor Creek, Sage Creek, and the Gallatin River, where willow thickets are common (Ripple and Beschta 2004).

Table 3.8-1. Common vegetation community types and associated species in the Gallatin Canyon study area. Associated species derived from Montana GAP analysis (Redmond et al. 1998), GNF vegetation classification (USDA Forest Service 2005c), and scientific literature. Defining characteristics of these community types are derived from the Montana GAP analysis (Redmond et al. 1998).

Vegetation Community Type	Defining Characteristics	Commonly Associated Species	
		Common Name	Scientific Name
Douglas-fir Forest	Dominated by 20-90% canopy cover Douglas-fir.	Douglas-fir ninebark snowberry bluebunch wheatgrass Idaho fescue pinegrass	*Pseudotsuga menziesii* *Physocarpus malvaceus* *Symphoricarpos* spp *Pseudoroegneria spicata* *Festuca idahoensis* *Calamagrostis rubescens*
Lodgepole Pine Forest	Dominated by 20-100% canopy cover lodgepole pine.	lodgepole pine huckleberry Oregon grape spirea grouse whortleberry arnica beargrass pinegrass	*Pinus contorta* *Vaccinium* spp. *Mahonia repens* *Spiraea betulifolia* *Vaccinium scoparium* *Arnica* spp. *Xerophyllum tenax* *Calamagrostis rubescens*
Mixed Douglas-fir and Lodgepole Pine Forest	Co-dominated by Douglas-fir and lodgepole pine to 40-90% canopy cover.	Douglas-fir lodgepole pine huckleberry Oregon grape spirea grouse whortleberry pinegrass	*Pseudotsuga menziesii* *Pinus contorta* *Vaccinium* spp. *Mahonia repens* *Spiraea betulifolia* *Vaccinium scoparium* *Calamagrostis rubescens*
Mixed Whitebark Pine Forest	Having greater than 10% whitebark pine canopy cover and a total conifer canopy cover 20-80%.	whitebark pine Engelmann spruce lodgepole pine subalpine fir huckleberry mountain heath grouse grouse whortleberry beargrass smooth woodrush	*Pinus albicaulis* *Picea engelmannii* *Pinus contorta* *Abies lasiocarpa* *Vaccinium* spp. *Phyllodoce glanduliflora* *Vaccinium scoparium* *Xerophyllum tenax* *Luzula hitchcockii*
Mixed Subalpine Forest	Having greater than 10% subalpine fir canopy cover with total conifer canopy cover 20-80%.	subalpine fir Douglas-fir Engelmann spruce lodgepole pine huckleberry menziesia grouse whortleberry arnica beargrass elk sedge	*Abies lasiocarpa* *Pseudotsuga menziesii* *Picea engelmannii* *Pinus contorta* *Vaccinium* spp. *Menziesia ferruginea* *Vaccinium scoparium* *Arnica* spp. *Xerophyllum tenax* *Carex geyeri*
Low and Moderate Cover Dry Grassland	Canopy cover of grass ranges from 20-70% and cover is dominated by short to medium height grasses	arrowleaf balsamroot bluebunch wheatgrass sedges	*Balsamorhiza sagittata* *Pseudoroegneria spicata* *Carex* spp.

Table 3.8-1. Common vegetation community types and associated species in the Gallatin Canyon study area. Associated species derived from Montana GAP analysis (Redmond et al. 1998), GNF vegetation classification (USDA Forest Service 2005c), and scientific literature. Defining characteristics of these community types are derived from the Montana GAP analysis (Redmond et al. 1998).

Vegetation Community Type	Defining Characteristics	Commonly Associated Species	
		Common Name	Scientific Name
	and forbs.	green needlegrass Idaho fescue lupine needle & thread timothy	*Nassella viridula* *Festuca idahoensis* *Lupinus* spp. *Hesperostipa comata* *Phleum pretense*
Sagebrush Shrubland	Having 20-80% canopy cover of sagebrush.	sagebrush species bluebunch wheatgrass Idaho fescue	*Artemisia* spp. *Pseudoroegneria spicata* *Festuca idahoensis*
Mixed Broadleaf and Conifer Riparian	Co-dominated by broadleaf and conifer trees that account for 20-100% canopy cover.	aspen birch cottonwood Douglas-fir Engelmann spruce subalpine fir alder serviceberry willow sedges	*Populus tremuloides* *Betula* spp *Populus* spp. *Pseudotsuga menzieseii* *Picea engelmannii* *Abies lasiocarpa* *Alnus* spp *Amelanchier alnifolia* *Salix* spp *Carex* spp.
Shrub Riparian	Dominated by 20-100% canopy cover of shrubs, less than 15% cover tree species, and shrubs dominate over herbaceous species.	alder black hawthorn bog birch currant red-osier dogwood rose shrubby cinquefoil snowberry willows	*Alnus* spp. *Crataegus douglasii* *Betula glandulosa* *Ribes* spp. *Cornus stolonifera* *Rosa* spp. *Dasiphora floribunda* *Symphoricarpos* spp *Salix* spp.
Graminoid and Forb Riparian	Dominated by 30-100% canopy cover herbaceous species and tree and shrub cover less than 15%.	Baltic rush reedgrass sedges cinquefoil hairgrass	*Juncus balticus* *Calamagrostis* spp. *Carex* spp. *Potentilla* spp *Deschampsia* spp.
Mixed Riparian	Co-dominated by a mix of shrub and herbaceous species, with tree canopy cover less than 15%.	alder black hawthorn bog birch currant red-osier dogwood rose shrubby cinquefoil willows Baltic rush reedgrass sedges hairgrass	*Alnus* sp. *Crataegus douglasii* *Betula glandulosa* *Ribes* spp. *Cornus stolonifera* *Rosa* spp. *Dasiphora floribunda* *Salix* spp. *Juncus balticus* *Calamagrostis* spp. *Carex* spp. *Deschampsia* spp.

3.8.3.2 Noxious Weeds

The Montana County Noxious Weed Management Act (7-22-2101 *et seq.*, MCA) declares statewide noxious weeds a common nuisance so that it is unlawful for any person to permit noxious weeds to propagate or produce seeds on their land (Grubb et al. 2003, WSSC 2005). Thirteen Montana and Gallatin County noxious weed species were observed in the study area during past inventories (Table 3.8-2) (USDA Forest Service 2002, Pauchard et al. 2003, DOT and MDT 2005, Kellar 2006, USDA Forest Service 2005c). Because not all areas were inventoried for noxious weeds and some of the noxious weed data are several years old, it is possible additional noxious weed species and locations occur in the study area (LaMont 2006).

Table 3.8-2. Noxious weeds observed in the study area during past inventories.

Common Name	Latin Name	Area Considered Noxious
Canada thistle	*Cirsium arvense*	State of Montana
common tansy	*Tanacetum vulgare*	State of Montana
Dalmatian toadflax	*Linaria dalmatica*	State of Montana
houndstongue	*Cynoglossum officinale*	State of Montana
leafy spurge	*Euphorbia esula*	State of Montana
musk thistle	*Carduus nutans*	Gallatin County
orange hawkweed	*Hieracium aurantiacum*	State of Montana
oxeye daisy	*Chrysanthemum leucanthemum*	State of Montana
poison hemlock	*Conium maculatum*	Gallatin County
St. Johnswort	*Hypericum perforatum*	State of Montana
spotted knapweed	*Centaurea maculosa*	State of Montana
sulfur cinquefoil	*Potentilla recta*	State of Montana
yellow toadflax	*Linaria vulgaris*	State of Montana

Noxious weed infestations range in size from individual plants to multiple acres. The majority of noxious weed locations in the Gallatin River drainage are within the study area footprint. In general, noxious weed species are present in areas of recent and historic disturbance, such as roadsides, urban development, and drainage bottoms affected by flooding. In the ORW study area, most noxious weed locations occur adjacent to the road, river, and in the Low and Moderate Cover Dry Grassland vegetation community type. The most prevalent noxious weed species are spotted knapweed, houndstongue, and Canada thistle.

3.8.3.3 Species of Concern

No threatened, endangered, or proposed/candidate plant species occur in the study area or within 10 miles of the study area footprint. Six vascular plant species of concern have occurrences either within the study area footprint or within 10 miles of the study area footprint (Table 3.8-3) (MNHP 2006a).

Large-leafed balsamroot is found in sagebrush and grasslands in the montane zone. In the Gallatin National Forest, it occurs most often on open, east-facing slopes (8-15%) in a Sagebrush community. Outlier occurrences are scattered through Douglas-fir and lodgepole pine forest types and in forest openings on steeper (45% slope), east-facing slopes with rockier and more clayey soils (MNHP 2006a). A large population (1,000-10,000 plants) of large-leafed balsamroot occurs approximately one mile west of the study area footprint (MNHP 2006a). The study area contains sagebrush and grassland community types that may provide additional suitable habitat.

Small-winged sedge occurs in dry, often rocky soil of grasslands and open forests in the montane and subalpine zones, and moist soil along streams in the valleys (MNHP 2006b). It occurs approximately five miles south of the study area along a tributary of the Gallatin River. Although it has not been found in the study area, similar suitable vegetative communities occur within the study area.

Annual Indian paintbrush is the only annual paintbrush in Montana. It occurs in moist alkaline meadows in the valley zone (MNHP 2006b). Several occurrences of annual Indian paintbrush are within the study area riparian communities on both sides of the Gallatin River. Estimated population size is 1,000-10,000 individual plants.

English sundew is a perennial herb occurring with sphagnum moss in wet, organic soils of fens in the montane zone approximately 10 miles west of the study area (MNHP 2006a, 2006b). It is unlikely that suitable habitat occurs in the study area.

Discoid goldenweed, a low growing shrub, grows in rocky, open, sparsely wooded slopes or coarse talus near or above treeline (MNHP 2006b). It grows in partial shade and is usually associated with sparse vegetation (MNHP 2006b). One occurrence of discoid goldenweed is present within the study area footprint.

Hall's rush is a perennial herb growing in moist to dry meadows and slopes, from valleys to montane zones (MNHP 2006b). It has been found within one-half mile of the study area footprint. The study area does contain moist riparian to dry meadow grasslands that may provide suitable habitat.

Table 3.8-3. Vascular plant species of concern within the study area footprint and within 10 miles of the study area.

Common Name	Scientific Name	State Rank [a]	Global Rank	Federal Agency Status FWS	FS	BLM
Large-leafed balsamroot	*Balsamorhiza macrophylla*	S1	G3, G5	None	Sensitive	Sensitive
Small-winged sedge	*Carex stenoptila*	S2	G2	None	None	None
Annual Indian paintbrush	*Castilleja exilis*	S2	G3, G4, Q	None	None	None
English sundew	*Drosera anglica*	S2	G5	None	Sensitive	None
Discoid goldenweed	*Haplopappus macronema* var. *macronema*	S1	G4, G5, T4	None	Sensitive	None
Hall's rush	*Juncus hallii*	S2	G4, G5	None	Sensitive	None

[a] Key to rankings:
G1/S1 Critically imperiled globally/state because of rarity (five or fewer occurrences in its range/state; or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction.
G2/S2 Imperiled globally/state because of rarity (6-20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction throughout its range.
G3/S3 Vulnerable throughout its range or found locally restricted (21-100 occurrences).
G4/S4 Apparently secure globally/state, though it might be quite rare in parts of its range, especially at the periphery.
G5/S5 Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery

T# Trinomial rank (T) used for subspecies or varieties, ranked on the same criteria as G1-G5.
Q Questionable taxonomy that may reduce conservation priority.

3.9 Wildlife

3.9.1 Overview

Wildlife habitat in the proposed ORW reach of the Gallatin River Canyon is primarily coniferous forest and riparian, with grassland and dry shrub communities occurring in the adjacent uplands (see Section 3.8.1). Riparian habitat (the zone of land associated with a water body; in this case, the Gallatin River) typically represents a higher wildlife species diversity than other habitat types (K. Alt, pers. comm. 2006, Van Kirk et al. 2000). The study area (defined as a one-mile-wide corridor on either side of the Gallatin River in the proposed ORW reach) encompasses an important wildlife movement corridor between the Madison and Gallatin mountain ranges (K. Alt, pers. comm. 2006). The study area provides excellent habitat for big game, as well as habitat for a number of federally listed and state sensitive wildlife species.

3.9.2 Inventory Methods

Biologists with the U.S. Forest Service (Gallatin National Forest) and Montana Fish, Wildlife and Parks were contacted for information on wildlife issues relative to the proposed action. The U.S. Fish and Wildlife Service was consulted for information on federally listed threatened, endangered, or proposed candidate species in the study area, and a Montana Natural Heritage Program database search was made to determine known sensitive species presence within 5 miles of the proposed ORW reach. The Environmental Assessment for STPHS 50-1(14)8: Gallatin Canyon Slope Flattening and Widening (DOT and MDT 2005) was consulted (this document covered the same reach of the Gallatin River), as well as other literature and websites providing wildlife information for this area.

3.9.3 Inventory Results

The study area provides excellent habitat for big game species such as moose, elk, mule deer, whitetail deer, and bighorn sheep. The study area between Karst and Big Sky (see Figure 1-1) is an important bighorn sheep winter area, and the entire study area provides both winter and summer range for elk, moose and, to some extent, mule deer (K. Alt, pers. comm. 2006). Big game, and other mammals known to occur in, and characteristic of, the study area are presented in Table 3.9-1.

Table 3.9-1. Wildlife species characteristic of the study area – mammals

Common Name	Scientific Name
Moose	*Alces alces*
Elk	*Cervus elaphus*
Mule deer	*Odocoileus hemionus*
Whitetail deer	*Odocoileus virginianus*
Bighorn sheep	*Ovis canadensis*
Grizzly bear	*Ursus arctos horribilis*
Black bear	*Ursus americanus*
Mountain lion	*Puma concolor*
Bobcat	*Felis rufus*

Table 3.9-1. Wildlife species characteristic of the study area – mammals

Common Name	**Scientific Name**
North American wolverine	*Gulo gulo luscus*
Marten	*Martes americana*
Longtail weasel	*Mustela frenata*
River otter	*Lontra canadensis*
Mink	*Mustela vison*
Beaver	*Castor canadensis*
Shrews	*Sorex* spp.
Snowshoe hare	*Lepus americanus*
Red squirrel	*Tamiasciurus hudsonicus*
Voles	*Microtus* spp.
Deer mouse	*Peromyscus maniculatus*
Western jumping mouse	*Zapus princeps*

Riparian habitat is important to neotropical migratory birds (birds that breed in the U.S. or Canada and winter in Mexico, Central or South America, or the Caribbean), such as the swifts, swallows, sparrows, flycatchers, orioles, vireos, and warblers found in the study area. Raptors and waterfowl are also present in the study area. Migratory songbirds and other avian species known to occur in, and characteristic of, the study area are presented in Table 3.9-2.

Table 3.9-2. Wildlife species characteristic of the study area – birds

Common Name	Scientific Name
White-throated swift	*Aeronautes saxatalis*
Swallows	*Tachycineta* spp.
Sparrows	*Emberizidae* family
Flycatchers	*Tyrannidae* family
Bullock's oriole	*Icterus bullockii*
Vireos	*Vireonidae* family
Warblers	*Parulidae* and *Peucedramidae* families
Osprey	*Pandion haliaetus*
Bald eagle	*Haliaeetus leucocephalus*
Northern harrier	*Circus cyaneus*
Red-tailed hawk	*Buteo jamaicensis*
Merlin	*Falco columbarius*
Peregrine falcon	*Falco peregrinus*
Canada goose	*Branta canadensis*
Mallard	*Anas platyrhynchos*
Teal	*Anas* spp.
Widgeon	*Anas americana*
Merganser	*Mergus* spp.

Amphibian species present include tiger salamander, boreal chorus frog, western toad, and Columbia spotted frog (Van Kirk et al. 2000). Reptiles include terrestrial garter snake and the rubber boa (Atkinson and Peterson 2000). Western toads are a state and Forest Service sensitive species, and, in general, their stronghold on the Gallatin National Forest is from the Taylor Fork south to Hebgen Lake, which encompasses the southern part of the study area (Atkinson and Peterson 2000, C. Sestrich, pers. comm. 2006). Amphibian and reptile species known to occur in, and characteristic of, the study area are presented in Table 3.9-3.

Table 3.9-3. Wildlife species characteristic of the study area – amphibians and reptiles

Common Name	Scientific Name
Tiger salamander	*Ambystoma tigrinum*
Boreal chorus frog	*Pseudacris triseriata*
Western toad	*Bufo boreas*
Columbia spotted frog	*Rana luteiventris*
Terrestrial garter snake	*Thamnophis elegans*
Rubber boa	*Charina bottae*

The study area provides access to some prime hunting for elk, moose, black bear, and deer, and receives heavy use relative to other areas of FWP Region 3 (C. Jourdonnais, pers. comm. 2006). The state-owned Porcupine Creek Wildlife Management Area contains important elk winter range, and the Porcupine Creek drainage receives heavy use by big game hunters (C. Jourdonnais, pers. comm. 2006). Other heavily used big game hunting areas include the Taylor Fork, Buffalo Horn, and Buck Creek drainages. Waterfowl hunting and trapping for furbearers are also wildlife-based activities in the area, and there is a limited hunting season for bighorn sheep in the northern part of the study area.

3.9.3.1 Species of Concern

Table 3.9-4 lists wildlife species currently listed under the federal Endangered Species Act which are known to occur, or which are likely to occur, in the study area (Wilson 2006).

Table 3.9-4. Federally listed wildlife species documented or which may be present within one mile of the Gallatin River in the proposed ORW reach.[a]

Species	**Status[b]**	**Expected Occurence**
Bald eagle (*Haliaetus leucocephalus*)	FT, PDL, MIS, S3, G5	Spring or fall migrant; winter resident
Canada lynx (*Lynx canadensis*)	FT	Possible resident in general area
Grizzly bear (*Ursus arctos horribilis*)	FT, PDL, MIS, S3	Transient or resident throughout area
Gray wolf (*Canis lupis*)	XN	Transient or resident throughout area

[a] MNHP 2006a; Wilson 2006
[b]Key to status:

FT	Federally threatened
XN	Experimental nonessential
PDL delist	Proposed for delisting - Any species for which a final rule has been published in the Federal Register to the species.
MIS	Gallatin National Forest Management Indicator Species; their status is believed to be indicative of the status of a larger functional group of species, be reflective of the status of a key habitat or biological community type, or act as an early warning of an anticipated stressor to ecological integrity.
S3	Potentially at risk because of limited and/or declining numbers, range, and/or habitat, even though it may be abundant in some areas.
G5	Common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range.

Federally Listed Species

Bald Eagle

In Montana, bald eagles primarily frequent large lakes, reservoirs, and major rivers. Fish is the major component of their diet, but waterfowl, seagulls, and carrion are also eaten. Bald eagles usually nest in trees near water and winter in areas with suitable night roosts offering an abundant and readily available food supply (near free-flowing portions of rivers or upland areas with ungulate carrion and small mammals).

The closest documented nest site to the study area is approximately 25 miles south of the southern boundary, on Hebgen Lake (DOT and MDT 2005). The study area receives some use by wintering bald eagles (B. Dixon, pers. comm. 2006).

Canada Lynx

In the Northern Rocky Mountains, the majority of lynx occurrences are associated with conifer forests above 1,250 meters (4,101 feet) elevation (Federal Register Nov. 9, 2005). The dominant vegetation that constitutes lynx habitat in these areas is subalpine fir, Engelmann spruce and lodgepole pine. Lynx distribution and abundance is closely associated with that of their primary prey species, the snowshoe hare. The USFWS has published a proposed rule to designate critical habitat for the lynx, but this proposal does not include any part of the study area for this EIS (Federal Register, Nov. 9, 2005).

The MNHP lists one lynx sighting approximately 2 miles east of the study area in Yellowstone National Park (MNHP 2006a).

Grizzly Bear

In Montana, grizzly bears occur in the northwestern part of the state and in the greater Yellowstone ecosystem. Grizzly bears use a wide variety of habitat types depending on season, local population, and individuals. The study area is part of an area proposed by the FWS as the Yellowstone “distinct population segment” (DPS) for the grizzly bear (Federal Register Nov. 17, 2005). FWS is proposing to remove this DPS from the threatened species list based on the recovery of grizzly bears in this region (Federal Register Nov. 17, 2005).

Gray Wolf

Wolves were reintroduced into the Greater Yellowstone area in 1995 and 1996. Wolves in this area are classified as an experimental, non-essential population. The study area is within the boundaries of the Chief Joseph wolf pack (DOT and MDT 2005). As of 2004, this pack still used its traditional den site in the northwest corner of Yellowstone National Park. The pack ranges seasonally north and west outside the park, likely into the study area (Smith et al. 2005).

The MNHP lists one wolf sighting from 2001, approximately 2 miles east of the southern boundary of the study area, in Yellowstone National Park (MNHP 2006a). The FWS intends to designate a distinct population segment of the gray wolf in the Northern Rocky Mountains, which includes the study area (Federal Register Feb. 8, 2006). This intention is based on an

assessment that threats to the wolf population have been reduced or eliminated, and the populations are exceeding recovery goals.

State and Forest Service Special Status Species

Species listed in Table 3.9-5 are wildlife species of concern in Montana, and those listed as sensitive or Management Indicator Species (MIS) by the Forest Service. Sensitive species include any species for which the Regional Forester has determined there is a concern for population viability within the state, as evidenced by a significant current or predicted downward trend in populations or habitat. Sensitive species are monitored by the Forest Service to determine if approval of a permit or implementation of an action would adversely affect the viability of the species or contribute to a trend toward federal listing under the ESA. MIS are selected because their populations are most likely to indicate the effects of management activities (36 CFR 219.19(a)(1). Consequently, MIS are monitored during forest plan implementation in order to assess the effects of management activities on their populations and the populations of other species with similar habitat needs which they may represent.

Table 3.9-5. State or Forest Service wildlife species of concern documented or which may be present within one mile of the Gallatin River in the proposed ORW reach.[a]

Common Name	Scientific Name	Status[b]	Expected Occurrence
Peregrine falcon	*Falco peregrinus*	S3B, FS	3 known eyries
Olive-sided flycatcher	*Contopus cooperi*	S3B	Documented in study area
Brewer's sparrow	*Spizella breweri*	S2B	Documented in study area
Elk	*Cervus elaphus*	MIS	Common throughout area
Marten	*Martes americana*	MIS	Occurs throughout area
North American wolverine	*Gulo gulo luscus*	FS	Occasional in study area
Northern leopard frog	*Rana pipiens*	FS	Uncommon but possible
Western toad	*Bufo boreas*	S2, G4, FS	Occasional, esp. south of Taylor Fork
Gallatin mountainsnail	*Oreohelix yavapai mariae*	S1	Last observed in 1976
Striate disk	*Discus shimekii*	S1	Last observed in 1960

[a] MNHP 2006a, USDA Forest Service 2005d.
[b]Key to status:

S1 At high risk because of extremely limited and/or rapidly declining numbers, range, and/or habitat, making it highly vulnerable to extirpation in the state.
S2B At risk because of very limited and/or declining numbers, range, and/or habitat, making its breeding status in the state vulnerable to extirpation.
S2 At risk because of very limited and potentially declining numbers, extent and/or habitat, making it vulnerable to global extinction or extirpation in the state.
S3B Breeding status in state potentially at risk because of limited and/or declining numbers, range, and/or habitat, even though it may be abundant in some areas.
FS Forest Service Sensitive
MIS Gallatin National Forest Management Indicator Species; their status is believed to be indicative of the status of a larger functional group of species, be reflective of the status of a key habitat or biological community type, or act as an early warning of an anticipated stressor to ecological integrity.
G4 Uncommon but not rare (although it may be rare in parts of its range), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern.

Peregrine Falcon

Peregrine falcons are listed as sensitive by the Forest Service. There are three known peregrine falcon eyries (nests) in the study area, all on National Forest System lands (B. Dixon, pers.

comm. 2006, MNHP 2006a): one has been active since 1994, one was first observed in 2000, and the third was first discovered in 2005.

Olive-sided Flycatcher

The olive-sided flycatcher breeds throughout the mountainous portions of western Montana. It is associated with post-fire habitats and is often found in forested edges near water. The MNHP lists five occurrences of this species in the study area (MNHP 2006a).

Brewer's Sparrow

Brewer's sparrows nest in sagebrush habitats throughout central Montana. MNHP (2006a) information shows one occurrence of Brewer's sparrow in the study area. This is near the confluence of Elkhorn Creek and the Gallatin River in the southern third of the proposed ORW reach.

Elk

Elk generally occur in coniferous forests interspersed with openings (grassland, burned areas, etc.). They occur throughout western Montana where this habitat is present. As mentioned above, the study area provides excellent year-round habitat for elk.

Marten

Martens occur in coniferous or mixed conifer forest with snags and deadfall, which they use, along with rock outcrops, for den sites. Martens occur throughout the study area in appropriate habitat.

North American Wolverine

Wolverines generally occur in alpine tundra and coniferous habitat. Wolverines are known for their wide-ranging movements, traveling as much as 40 miles (Streubel 1989). Wolverines cross between the Madison and Gallatin mountain ranges through the study area (K. Alt, pers. comm. 2006).

Northern Leopard Frog

Northern leopard frogs occur in central and eastern Montana in a variety of wetland habitats, including springs, slow streams, marshes, bogs, ponds, canals, flood plains, beaver ponds, reservoirs, and lakes, usually in permanent water with rooted aquatic vegetation (MNHP 2006c). Van Kirk et al. (2000) reported the occurrence of a small number of northern leopard frogs in the Greater Yellowstone Ecosystem (of which the study area is a part). Due to their preference for slower moving waters, it is unlikely they are present in the proposed ORW reach of the Gallatin River. Limited surveys conducted in 1999 did not find them in the study area, and this species has undergone significant reductions in populations (Atkinson and Peterson 2000). They might occur in ponds or meadows in the study area, but this is not likely.

Western Toad

Western toads occupy low elevation beaver ponds, reservoirs, streams, marshes, lake shores, potholes, wet meadows, and marshes, to high elevation ponds, fens, and tarns at or near treeline (MNHP 2006c). Adults often use a variety of terrestrial habitats. During surveys conducted in

1999, they were found in areas close to but not within the study area, including Rat Lake, a side channel of the North Fork Cache Creek (a tributary of the Taylor Fork), and a subalpine pond in the Teepee Creek drainage (Atkinson and Peterson 2000). In general, the area from Taylor Fork south to Hebgen Lake constitutes their stronghold on the GNF (C. Sestrich, pers. comm. 2006); this area encompasses the part of the ORW reach study area from Taylor Fork to the boundary with Yellowstone National Park. They are unlikely to occur in the ORW reach itself, but possibly in wetlands and meadows within the study area, especially south of Taylor Fork.

Gallatin Mountainsnail

The Gallatin mountainsnail is a terrestrial snail typically inhabiting open and somewhat dry, limestone talus and outcroppings (NatureServe 2006). Little is known about this species. The only sighting reported by MNHP (2006a) was from 1976 along Storm Castle Creek, in the northern part of the proposed ORW reach.

Striate Disk

The striate disk is also a terrestrial snail with little known about its ecology. MNHP (2006a) reported one observation of this snail in the study area from 1960. This occurrence was near the confluence of Deer Creek and the Gallatin River, in the central part of the proposed ORW reach.

3.10 Air Quality

3.10.1 Overview

Air quality is generally determined by the concentrations of pollutants in the atmosphere. EPA has set standards for some of these pollutants, known as the National Ambient Air Quality Standards (NAAQS). The NAAQS are maximum pollutant concentrations that EPA has deemed acceptable while adequately protecting the public health and welfare. DEQ has also developed a set of standards known as the Montana Ambient Air Quality Standards (MAAQS).

EPA has identified pollutants of concern known as "criteria" pollutants. Criteria pollutants are nitrogen oxides (NO_x), sulfur dioxide (SO_2), volatile organic compounds (VOC, a precursor to ozone formation), carbon monoxide (CO), particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$), less than 10 microns (PM_{10}), and lead.

EPA developed Prevention of Significant Deterioration (PSD) rules for areas whose criteria pollutant air pollution levels are less than or "attaining" the NAAQS. The air quality regions currently in compliance with the NAAQS are known as "attainment" areas. PSD rules allow for three types of air quality classes, defined below. Increases in air pollution are subject to more or less scrutiny depending on the proposed location of emissions, designated class of the airshed, and expected pollution increase. If pollution increases are significantly small, only DEQ minor source air quality rules apply.

Mandatory Class I areas are pristine areas, such as some wilderness areas and national parks. Other areas may apply for Class I status if considered valuable air sheds. All remaining areas in the country were initially set to Class II status. Class II air regulations are designed to allow for moderate, yet managed, industrial growth. PSD regulations allow areas to be reclassified as Class III areas, depending on local land management objectives. Class III areas are generally urban areas; however, this classification is not relevant to the proposed ORW reach. EPA has established "PSD Increments" for Class I and II areas, once a specific baseline date has been established. These increments are the maximum allowable increases in pollution level concentrations that may not be exceeded for each pollutant in an attainment area. The purpose of the PSD increment is to allow for growth while assuring that NAAQS compliance is preserved. The NAAQS, MAAQS, and PSD increments are provided in Table 3.10-1 below.

Table 3.10-1. National Ambient Air Quality Standards (NAAQS), Montana Ambient Air Quality Standards (MAAQS), and Prevention of Significant Deterioration (PSD) increments (EPA 1990, DEQ 2006b).

Pollutant	Averaging Period	NAAQS ($\mu g/m^3$)	MAAQS ($\mu g/m^3$)	PSD Class I Increment ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)
Nitrogen Oxides (NO_x)	1-hour	---	564	---	---
	Annual	100	94	2.5	25
Sulfur Dioxide (SO_2)	1-hour	---	1,300	---	---
	3-hour	1,300	---	25	512
	24-hour	365	262	5	91
	Annual	80	52	2	20
Ozone (O_3)	8-hour	157	196	---	---
Carbon Monoxide (CO)	1-hour	40,000	26,450	---	---
	8-hour	10,000	10,350	---	---
Particulate Matter <10µm (PM_{10})	24-hour	150	150	5	30
	Annual	50	50	4	17
Particulate Matter <2.5µm ($PM_{2.5}$)	24-hour	65	---	---	---
	Annual	15	---	---	---
Lead	Calendar Quarter	1.5	1.5	---	---
	Monthly	---	1.5	---	---

3.10.2 Inventory Methods

The study area for air quality was defined as Gallatin County, with a focus on the population centers near the proposed ORW reach. The area was not limited further because air quality data are not available at a finer resolution. DEQ was contacted to determine what air quality monitoring, if any, has occurred within the study area. Because significant effects on air quality under this project are unlikely, no specific air quality monitoring was conducted. Instead a review of available information, regulatory guidelines and standards, and related studies was conducted, and summarized herein.

3.10.3 Inventory Results

Gallatin County is listed as either better than the national standards or “unclassifiable” and therefore assumed to be in attainment of the National Ambient Air Quality Standards. Unclassifiable areas are regions where no monitoring has been completed and knowledge of the activities in the area indicates that no air pollution problem exists. EPA lists the attainment status for Montana air quality regions in the Code of Federal Regulations at 40 CFR 81.327. Gallatin County is considered a Class II area and is located next to Yellowstone National Park, which is a Class I area.

DEQ personnel indicated that three monitoring sites were near the study area. Two sites, Belgrade and the West Yellowstone National Park entrance, were not considered representative of the study area. Belgrade is more industrialized, and the park entrance site is specifically designed to monitor snowmobile traffic. A third site in downtown West Yellowstone was determined to be the most representative of the study area. Because the monitor is in a traffic area, the results will likely be higher than expected in the vast majority of the study area. Only PM_{10} is monitored at this location. Table 3.10-2 below provides a summary of the data collected as provided by DEQ.

Table 3.10-2. Downtown West Yellowstone PM_{10} monitoring data 1996-2004.

Year	Annual Average PM_{10} ($\mu g/m^3$)
1996	22.3
1997	20.9
1998	17.9
1999	17.9
2000	16.4
2001	17.9
2002	13.2
2003	15.4
2004	14.3

Comparing the values monitored in West Yellowstone (Table 3.10.2) to the NAAQS and MAAQS standards (Table 3.10.1), the monitored air quality in the study area is consistently less than half of the National Ambient Air Quality Standard for PM_{10} of 50 $\mu g/m^3$ for a Class I area.

3.11 Cultural Resources

Cultural resources are sites, features, structures, or objects that may have significant archaeological and historic values. Additionally, they are properties that may play a significant traditional role in a community's historically-based beliefs, customs, and practices. Cultural resources encompass a wide range of sites and buildings from prehistoric campsites to farmsteads constructed in the recent past, as well as traditional cultural properties (TCP) still used today.

3.11.1 Overview

No single cultural resource study or overview has been completed for the current project study area. All of the information contained here is gathered from existing sources for southwest Montana, as well as a summary history for the Gallatin Canyon.

Numerous excellent works exist that detail the historical, archaeological, and ethnographic setting of the Northern Rocky Mountains and, specifically, the area of southwest Montana (Frison 1978, Janetski 2002, Baumler et al. 1996, Baumler and Eckerle 1999, DiMallie 2001a,b). A very brief glimpse of the prehistoric cultural setting of the area is presented here. Details of the history of the Gallatin Canyon area can be found in Bates (1994) and Smith (2002). The most comprehensive treatise on the history of the area is presented in *Montana's Gallatin Canyon* (Cronin and Vick 1992).

3.11.1.1 Prehistoric Period

Archaeological, historical, and ethnographic literature paint a picture of the historic and proto-historic use of southwest Montana by native peoples. The area can be seen as a location of overlapping boundaries of numerous tribal groups whose traditional territory extended a considerable distance away from the headwaters of the Missouri, Gallatin, and Yellowstone rivers.

Following game and resources, tribal groups, including the Crow, Blackfeet, Shoshone, Shoshone-Bannock, as well as the Sheepeater band of Shoshone-related peoples, frequented the area. Historic information exists indicating that other tribal groups ventured into southwest Montana on a sporadic or limited basis, resulting in an overlap with the Flathead peoples, for example. The boundaries separating the various tribal groups were not absolute or constant through time.

Before the nineteenth century, bands of Shoshone and Salish-speaking peoples (Flathead and Pend Oreilles) hunted and probably spent the winters near the upper reaches of the Missouri River (Greiser 1983). By the time that Lewis and Clark traveled through the area in 1805, the Shoshone and Salish were living west of the Continental Divide. However, it is known that the two groups ventured east on yearly trips across the Rockies to hunt bison. Annual bison trips were also taken by the Kootenai, Nez Perce, and other groups.

At the time of Lewis and Clark's expedition from St. Louis to the Pacific Coast, from 1804-1806, it was noted that the Blackfeet controlled much of the area of what is today southwest

Montana, and specifically the region north of Yellowstone National Park; but other groups frequented the area (Moulton 1993, Janetski 2002). In his journal notes of July 14, 1806, William Clark mentioned the following information while traveling eastward through the Gallatin Valley:

> "... Small parties of the Shoshones do pass over to the plains for a few days at a time and kill buffalow for their Skins and dried meat, and return immediately into the Mountains." (Moulton 1993: 82)

Although known on a limited basis, the area of the Gallatin Canyon has representative sites from all of the recognized chronological periods from the Early Prehistoric Period (ca. 13,000 - 7500 years before present (B.P.)), when hunting was limited to spears and projectile point weapons, to the Protohistoric Period (ca. 300 - 200 years B.P. (A.D. 1700-1800), after the introduction of the horse when the Plains trade network expanded significantly (Greiser 1983).

It is likely that many more sites exist than have been found. However, a clear picture of a complex cultural system is evident. The Gallatin River study area, and its immediate surroundings, is a small window into this cultural heritage.

Throughout the mid-twentieth century, archaeological projects were rather few and limited in research scope. Hence, the region adjacent to the culture areas of the Great Plains was often overlooked or assumed to be limited in use and importance. Earlier research perspectives sometimes found the foothills-mountains area was a locale of limited focus, only used when the severe constraints of seasonal climate and resources allowed.

Baumler et al. (1996) makes a special case that current archaeological research in the foothills-mountain zone, particularly near the Gallatin River, indicates that this unique transition area of the Northern Rockies was used throughout most of the prehistoric past and with much intensity.

3.11.1.2 Historic Period

As historic populations and development grew in the Gallatin Valley, people ventured up the Gallatin River canyon for important resources, settlements, and recreation.

Following Lewis and Clark's Corps of Discovery travels through the northern Rockies in 1804-1806, European trappers and hunters ventured into the area surrounding the Gallatin Canyon. According to Thomas Michener's early historical accounts of the canyon, trappers representing the American Fur Company were possibly the first white men to explore the upper reaches of the Gallatin Canyon beginning in 1812 (Cronin and Vick 1992). According to Michener (Cronin and Vick 1992), Jim Bridger sketched a detailed map showing the upper Gallatin from its headwaters at the south to the Porcupine and Beaver Creek drainages near present-day Big Sky.

Mining in the Gallatin Canyon was an important historic pursuit, although not as profitable as other areas of Montana. Walter de Lacy pursued gold prospecting at Alder Gulch during 1863, then explored the upper Snake River area to the headwaters of the Gallatin (Cronin and Vick 1992). The expedition's journey ended with travels down the Gallatin River while panning for gold, including panning in most of the streams along the way. Later, in 1912, Pete Karst discovered asbestos deposits on the Gallatin near Karst Ranch, which proved to be quite

profitable (Cronin and Vick 1992). Other mining operations included the development of the Hercules Dredging Company's operation for placer gold mining on the Gallatin during the early twentieth century (Cronin and Vick 1992).

With the construction of the Great Northern Railroad to Bozeman in 1882-83, logging operations accelerated in the mountains adjacent to the Gallatin River. Trees for lumber, fuel, and ties were a highly prized commodity. Major lumber camps dotted the Gallatin Canyon as far upstream as Taylor Fork. Logs were floated down the swollen spring runoff to sawmills in Salesville (Gallatin Gateway) and the Gallatin Valley (Cronin and Vick 1992, Bates 1994).

During the mid-nineteenth century, a trapper by the name of Nels Murry and his associates improved the various Indian trails through the Gallatin Canyon to handle the increasing numbers of pack-trains. In 1883, the Gallatin County Commissioners enlisted the services of an engineer named Bundock to survey the location of a wagon road through the Gallatin Canyon to the northwest corner of Yellowstone National Park (Cronin and Vick 1992). A later survey was made by C.M. Thorpe, and the road was built and ready for the first wagon in 1898.

With the advent of a more reliable transportation route through the canyon, a range of activities and enterprises blossomed. A new avenue for recreation and access to Yellowstone saw the development of numerous recreation cabins and dude ranches, including Karst, Rainbow Ranch, Cinnamon Ranch, and the 320 Ranch. The first ranger station was constructed at Cinnamon, with an elaborate station and Civilian Conservation Corps camp built at Storm Castle Creek in the 1930s.

Agriculture and summer cattle grazing were an important endeavor in the canyon in the early twentieth century. Durnham Meadow became a famous farm operation for lettuce to be shipped throughout the country in the early twentieth century. Homesteads and cow camps, including those of the Micheners, Lytles, Johnsons, Burnetts, and Crails, dotted the Gallatin River canyon. The first school, Ophir, was established near the West Fork of the Gallatin River in 1928.

The early-to-mid-1900s exhibited a mild growth in development and visitation of the Gallatin Canyon. Following World War II, a stellar growth in U.S. economy, and exploding travel throughout the West, the Gallatin Canyon saw an increase in population. Soldiers Chapel was built in 1955 near the Michener homestead at the West Fork Gallatin River. Construction of summer homes turned to year-round facilities. Big Sky Resort, including the now famous ski area, was developed by Chet Huntley in 1973, which ushered in the current chapter of the history of the Gallatin Canyon.

3.11.2 Inventory Methods

Because of the lack of potential significant effects on cultural resources under this project, no specific cultural resource survey or overview was conducted. Instead, a detailed file search and data review was made of the records filed at the Montana State Historic Preservation Office in Helena and the Gallatin National Forest in Bozeman, as well as area libraries and literature collections, including Montana State University, Bozeman, Bozeman Public Library, and the Gallatin Historical Society.

In order to carry out a file search and data review, a study area for cultural resources was defined as the surveyed land sections within 1 to 1.5 miles on either side of the Gallatin River, from the confluence with Spanish Creek on the north to the intersection of the Yellowstone National Park boundary with the Gallatin River near Daly and Lodgepole creeks on the south. The sections covered in the data search are listed in Appendix C, and include approximately 114 square miles of area. The stretch of the Gallatin River through the study area extends approximately 38 miles.

Summary presentations from the SHPO Cultural Resource Information System (CRIS) report and the Cultural Resource Annotated Bibliography System (CRABS) report are contained in Appendix D.

3.11.3 Inventory Results

Appendix E presents a summarization of the cultural resource site data on file at the Montana State Historic Preservation Office (SHPO) and the Gallatin National Forest office. These data are the result of numerous cultural resource inventory and research projects. As stated earlier, only a small portion of the current project study area has been previously subjected to controlled archaeological or historical examinations. It is likely that many more cultural resource sites exist within the proposed ORW reach of the Gallatin River corridor.

Appendix E lists the official Smithsonian site number designation, the estimated time period of each site, a brief description of the site type as known from survey records, the current land owner, and a statement of the current National Register status for each site. The “Time Period” designation presented here is only a general estimate of “Prehistoric” or “Historic” periods. Some sites are categorized to both time periods, with some listed as “No Data.” It should be stressed that further investigation of any sites may yield more information to refine or expand the time period of occupation or use.

The “Site Type” designation is a brief reference to the main cultural constituents recorded for each site. These include a range of historic sites from roads, trails, structures, houses, irrigation systems, ranger stations, lookouts, dude ranches, quarry and mining debris, and a camp constructed for the Civilian Conservation Corps. Prehistoric sites include lithic scatters, which include chipping debris and stone tools, possible rock shelters, fire hearths, tipi rings, and related material. For the purposes of this overview study, the transition from prehistory to the historic period may not be clearly reflected in the documented surface remains of any one site. Some sites currently listed as “Prehistoric” may yield, through further in depth study, more specific data pertaining to occupation and use.

Within the study area of the Gallatin River corridor from Spanish Creek to the Yellowstone National Park boundary, there are 100 cultural resource properties documented in the SHPO and Forest Service files. No cultural resource properties have been recorded within the current water course of the Gallatin River. The number of sites listed by site types and National Register status designation is presented in Table 3.11-1 below.

The recorded sites represent the full span of cultural history from the early prehistoric period (approximately 10,000 years ago), through the sequence of the prehistoric phase, into the early historic period of Gallatin County and, specifically, Gallatin Canyon. Anecdotal information exists supporting the existence of early prehistoric period use, including Clovis phase artifacts, within the canyon.

Table 3.11-1. Summary of site type data for the area surrounding the proposed ORW reach of the Gallatin River.

Time Period	Number of sites
Prehistoric	64
Historic	24
Prehistoric/Historic	8
no data	4
Total	**100**

National Register Status	Number of sites
Undetermined	96
Unresolved	1
Listed on the National Register	1
Consensus Determination	2
Total	**100**

Cursory review of existing cultural resource data indicates that the prehistoric period sites within the project study area span the full range of prehistoric periods from the Paleo period (approximately 10,000 years ago) to the early nineteenth century. Historic sites represent all of the major periods and activities within the Gallatin River Canyon, including mining, lumbering, agriculture, transportation via roads and trails, residences, and recreation activities. Details of these sites and related events are contained within the site records and project reports on file at the Montana SHPO, as well as other works referred to in this section.

3.12 Aesthetics

3.12.1 Overview

This section describes the existing visual resources within the study area. For the aesthetics analysis, the study area was defined as the entire viewshed from the river channel to the canyon ridgecrests to the east and west (as seen from the river), major tributaries within the footprint, and highways/roadways. Topography that was not visible from these vantage points was excluded from consideration.

Within the footprint of the proposed ORW reach are three primary visual perspectives: from, or near U.S. Highway 191; residential/commercial areas; and areas of recreational activity (campgrounds, trailheads, and the river itself). The primary viewers of the proposed action are those people traveling U.S. Highway 191 and those living along the Gallatin River. Viewsheds within the study area vary from expansive to limited, depending on local topography and the presence or absence of surrounding vegetation.

3.12.2 Inventory Methods

Because of the lack of potential significant effects on aesthetic resources under this project, no specific viewshed or aesthetic resource survey was conducted. Instead a review of available information and related studies was conducted, and summarized herein.

There are no formal guidelines for managing visual resources on private, state, or county-owned lands found within the vicinity of the study area. However, the Gallatin Canyon/Big Sky Planning and Zoning District Regulations and South Gallatin Zoning Ordinance both state that one of their objectives is the preservation of the scenic beauty and natural environment of the Districts (GC/BSCZ 1996). The forest plan for the Gallatin National Forest has visual quality objectives, which provide guidance for all landscape-altering activities. As defined in the forest plan, these objectives include a desired level of scenic quality and diversity of natural features based on physical and sociological characteristics of an area (USDA Forest Service 1987).

3.12.3 Inventory Results: Regional Setting and Landscape Character Type

Overall, the study area contains visual resources such as Sheep Rock, Storm Castle Mountain, Red Cliff, and the Gallatin River corridor. The Madison range to the west, and the Gallatin range to the east, frame the river, providing scenic views throughout the canyon. Steep cliffs, mountains, perennial and ephemeral drainages, riparian vegetation, grasslands, shrublands, and large expanses of forested hillsides influence the natural visual setting. There are no designated historical landmarks in the area. Human-built features that influence the visual setting throughout the length of the study area include U.S. Highway 191, residential and vacation housing, Forest Service-developed campgrounds, undeveloped camping areas, and dispersed commercial development. Centralized commercial development occurs at the junction with State Highway 64 (Big Sky Spur Road).

Chapter 4 Alternatives Analysis

4.1 Introduction

Chapter 4 describes potential impacts to the existing environment that could occur due to the Proposed Action, the No Action, and the Cumulative Impacts Analysis alternatives (i.e., the alternatives carried forward for detailed analysis). In contrast to many EIS analyses, where alternatives assess how proposed changes will affect an environment, the Proposed Action Alternative analyzes the impacts of maintaining the existing water quality conditions in the Gallatin River. The No Action Alternative analyzes the impacts of maintaining the existing regulatory environment. The Cumulative Impacts Analysis Alternative analyzes the impacts of DEQ exercising its discretionary right to review cumulative impacts of multiple developments on the ORW reach.

Each alternative is described in Section 2.2 of Chapter 2. Chapter 4 serves three purposes: (1) it provides an analysis and comparison of alternatives and their impacts; (2) it ensures that the Board has a clear understanding of the potential impacts, both positive and negative, of all alternatives under consideration; and (3) it provides the public with information to evaluate DEQ's alternatives, including the Proposed Action. Impacts are assessed for the same environmental components discussed in Chapter 3, including water, geology, soils, land use, socioeconomics, aquatic life, fisheries, vegetation, wildlife, air, cultural resources, and aesthetics. Impact analyses for each resource are limited to the affected environment described in Chapter 3.

MEPA defines three levels of potential impacts: primary, secondary, and cumulative. In some instances, impacts can be minimized or avoided altogether by making changes to an alternative. These changes are called "mitigation." Mitigation may become part of a preferred alternative if the decision makers decide that the mitigation significantly reduces impacts and can reasonably be incorporated into the alternative. The three levels of impacts and potential mitigation are examined for each resource area as described below. Some impacts may persist even with mitigation; these are called "residual impacts" under MEPA and are discussed at the end of this chapter.

4.1.1 Primary Impacts

Primary impacts are defined by MEPA as those impacts that have a direct cause and effect relationship with a specific action, i.e., they occur at the same time and place as the action that causes the impact. Because the Proposed Action, Cumulative Impacts Analysis, and No Action alternatives are regulatory in nature, there would be no immediate environmental consequence of implementing one or the other alternatives. The principal effects would be limited to the change, or lack of change, in the water quality regulations that are enforced along the proposed ORW reach of the Gallatin River. The most obvious and immediate result of implementing the Proposed Action would be changes to the processing of wastewater discharge permits and subdivision public wastewater applications. As a consequence, most of the impacts caused by each of the alternatives fall under the category of "Secondary Impacts."

4.1.2 Secondary Impacts

Secondary impacts to the human environment are indirectly related to the agency action, i.e., they are induced by a primary impact and occur at a later time or distance from the triggering action. For example, as stated above, the primary impact from the Proposed Action would be to trigger secondary impacts such as improvements to water quality.

4.1.3 Cumulative Impacts

Cumulative impacts are the collective impacts on the human environment of the Proposed Action, Cumulative Impacts Analysis or No Action alternatives when considered in conjunction with other past, present, and future actions related to the alternative under consideration by location or generic type. Cumulative impacts can thus result from individual actions that are minor, but, when combined over time with other actions, become significant. These reasonably foreseeable actions were described in Chapter 3, but their interactions with the alternatives will be analyzed in this chapter.

4.1.4 Mitigation

Mitigation includes any and all actions that DEQ could take to reduce adverse impacts of the alternative being reviewed, such as:

(a) Avoiding an impact by not taking a certain action or parts of an action;
(b) Minimizing impacts by limiting the degree or magnitude of an action and its implementation;
(c) Rectifying an impact by repairing, rehabilitating, or restoring the impaired resource; or
(d) Reducing or eliminating an impact over time by preservation and maintenance operations during the life of an action or the time period thereafter that an impact continues; and
(e) Compensating for the impact by replacing or providing substitute resources or environments.

The regulatory actions being considered under the Proposed Action Alternative and the Cumulative Impacts Analysis alternatives are specific to the proposed ORW reach of the Gallatin River; therefore, (e) is not applicable in either instance. Any impacts to the proposed ORW reach cannot be mitigated by substituting or replacing the reach with another. To be considered, mitigations must functionally reduce impacts related to an alternative under consideration; therefore, studies, monitoring plans, and further consultation do not satisfy the requirements of mitigation under MEPA.

4.1.5 Residual Impacts

Residual impacts are those that cannot be avoided, even with mitigation. These are summarized for all resource areas at the end of this chapter.

4.2 Geology and Soils

This section presents impacts related to the geology and soils of the study area described in Section 3.2. In general, the regulatory nature of the alternatives under consideration limits impacts to these resources; however, actions connected to the alternatives would have potential impacts.

4.2.1 No Action Alternative

The No Action Alternative would likely include further development of residential and commercial units served by subsurface wastewater treatment systems within the vulnerability footprint under the current DEQ nondegradation guidelines. This alternative would necessarily differ from the Proposed Action Alternative regarding potential impacts to soils and geology from other sources of nutrients not affected by ORW designation.

4.2.1.1 Primary Impacts

There are no known primary impacts to geology and soils that would distinguish the No Action Alternative from other alternative. Disturbance of the geology and soils could occur under any alternative considered (due to house construction, landscaping, or road construction for example), even though the management of wastewater associated with that development would likely be different.

4.2.1.2 Secondary Impacts

If there is an increase in numbers of subsurface wastewater treatment systems within the vulnerability footprint, there would be an increase in nutrient loading to the soils. Subsurface wastewater treatment systems use soils for attenuation of nutrients through biological and other physical-chemical processes to either naturally degrade or attenuate nutrients. Phosphorus, in particular, is attenuated as it is adsorbed to surfaces in soils. Current nondegradation analysis restricts phosphorus break-through to surface water to less than 50 years based on the analysis or site-specific information and evaluation (DEQ 2005a). Therefore, with an increase in overall loading of nutrients, soils may be affected by nutrient saturation, primarily by phosphorus. Nutrient saturation occurs when the soil reaches its limit in terms of binding or adsorbing nutrients. The overall result would be to increase the mass of soil containing or holding contaminants within the vulnerability footprint area. Since some attenuation processes such as adsorption are potentially reversible, transport of these nutrients to the receiving waters at some future time could occur.

More development within the study area would also increase soil disturbance. There would thus be a greater likelihood that erosion of disturbed soils could degrade water quality. There would also be a greater likelihood for additional disturbance of wetlands and riparian habitat under this alternative, from both direct impacts (see Section 4.8) and secondary impacts, as a result of increased sedimentation.

4.2.1.3 Cumulative Impacts

The cumulative impacts of development to geology and soils would be similar to those of the Proposed Action Alternative. Development in the footprint area could occur with the same or greater density, within the limits of zoning regulations, if alternative wastewater treatment facilities were employed (Section 4.3).

4.2.1.4 Mitigation

Conventional mitigation measures for geology and soils would include the control of surface soil erosion and the use of replacement areas, e.g., areas used for the drainfields in the subsurface wastewater treatment systems when the original area is no longer working effectively. Erosion control would include Storm Water Permits with the appropriate storm water management plans incorporating Best Management Practices (BMPs), such as silt fences and other storm water runoff settling or diversion devices. Appropriate use of erosion control devices would reduce sediment loading to the receiving waters and reduce site-specific erosion from soil disturbances around developments.

The use of replacement areas for subsurface wastewater treatment systems would increase their efficiency and reduce the nutrient loading of soils after long-term use. Also, the long-term monitoring of subsurface wastewater treatment systems by using soil analysis or down gradient groundwater monitoring could determine efficiency of the subsurface wastewater treatment systems and help evaluate local nutrient loading to soils.

4.2.2 Proposed Action Alternative

The Proposed Action Alternative would primarily limit sources of nutrients within the vulnerability footprint to comply with the “no permanent water quality change” criterion [(75-5-316(2)(b)] within the proposed ORW reach of the Gallatin River.

4.2.2.1 Primary Impacts

There are no known primary impacts to geology and soils that would distinguish the Proposed Action Alternative from other alternatives. Disturbance of the geology and soils could occur under any alternative considered, even though the management of wastewater associated with that development would likely be different.

4.2.2.2 Secondary Impacts

In order to prevent a measurable water quality change in receiving streams, the sources of nutrient loads to groundwater hydrologically connected to streams within the vulnerability footprint would have to be limited. Nutrient loading to soils from subsurface wastewater treatment systems within the vulnerability footprint of developable lands would be reduced with implementation of the Proposed Action Alternative.

In the short term, limiting development within the vulnerability footprint could shift some development to terrain less amenable to development, for example, terrain with steeper slopes or less stable soils. Such a shift could lead to more soil disturbance in steeper areas with higher

erosion potential; however, current development trends in the Big Sky Area indicate that construction in steep terrain would likely occur regardless of the Proposed Action.

Another potential scenario that could occur as a result of the Proposed Action Alternative is that most future subsurface wastewater treatment systems would be located outside of the vulnerability footprint, but the homes would be located inside the vulnerability footprint area. Such a scenario could encourage construction of larger community wastewater treatment systems (as opposed to individual wastewater systems), because it can be financially and logistically easier to create a single, larger remote wastewater treatment system than to create multiple remote smaller wastewater systems. Developments that utilize community utilities typically have a higher density than those that use individual wastewater systems. Therefore, the Proposed Action Alternative could potentially result in more and higher density housing proximal to the Gallatin River.

4.2.2.3 Cumulative Impacts

The cumulative impact of development to geology and soils would be similar to that of the No Action Alternative. Development in the footprint area with a density equal to or greater than that under the No Action Alternative could occur if alternative wastewater treatment facilities were employed.

4.2.2.4 Mitigation

With little or no difference in impacts to geology or soils as a result of the Proposed Action Alternative, there would be no need for additional mitigation measures, beyond the conventional measures discussed in the No Action Alternative.

4.2.3 Cumulative Impacts Analysis Alternative

4.2.3.1 Primary Impacts

There are no known primary impacts to geology and soils which would distinguish the Cumulative Impacts Analysis Alternative from other alternatives. Disturbance of the geology and soils could occur under any alternative (due, for example, to house construction, or road construction), even though the management of wastewater associated with that development would likely differ.

4.2.3.2 Secondary Impacts

Secondary impacts to soils and geology as a result of the Cumulative Impacts Analysis Alternative would be the same as those under the Proposed Alternative. The sources of nutrient loading to groundwater hydrologically connected to streams within the footprint would have to be limited. This limitation would reduce nutrient loading to soils from subsurface wastewater treatment systems on developable lands within the footprint.

The Cumulative Impacts Analysis Alternative, as in the Proposed Action Alternative, may limit development within the footprint after cumulative impacts have reached the trigger values for water quality (in this case, phosphorus). In the short term, it could shift some development to

terrain less amenable to development, such as terrain with steeper slopes or less stable soils. Such a shift could lead to more soil disturbance in steeper areas with higher erosion potential; however, current development trends in the Big Sky Area indicate that construction in steep terrain would likely occur regardless of the effects of the Cumulative Impacts Analysis Alternative.

As with the Proposed Action Alternative, the Cumulative Impacts Analysis Alternative could result in future subsurface wastewater treatment systems that are located outside of the footprint, while the homes are located inside the footprint. Encouragement of larger community wastewater treatment systems could occur, and such developments utilizing community utilities typically have higher densities than those using individual wastewater systems. Therefore, the Cumulative Impacts Analysis Alternative could result in more and higher density housing close to the Gallatin River.

4.2.3.3 Cumulative Impacts

The cumulative impacts of development to geology and soils would be similar to those of the No Action and Proposed Action Alternatives. Development in the footprint area could occur with the same or greater density, within the limits of zoning regulations, if alternative wastewater treatment facilities were employed.

4.2.3.4 Mitigation

Conventional mitigation measures for geology and soils would include the same control measured outline for the No Action and Proposed Action Alternatives.

4.3 Hydrology and Water Quality

The primary emphasis of the Proposed Action Alternative is water quality. The regulation of water quality would affect the spatial arrangement and density of allowed development under all alternatives. As such, the mitigations presented are similar under each alternative, but their aim is different. For example, the No Action Alternative would degrade water quality over time. Therefore, under the No Action Alternative, mitigations to reduce nutrient loading focus on reducing impacts of development on water quality. In contrast, the Proposed Action Alternative has the potential to impact development; therefore, under the Proposed Action Alternative, the same proposed mitigations focus on reducing the impacts to development of maintaining water quality.

4.3.1 No Action Alternative

The No Action Alternative implies that water quality would be regulated under existing rules and policies of the DEQ and counties. Local governments are required to comply with nondegradation requirements for developments that are not reviewed by DEQ. Current rules and policies are described in Chapter 2.

Current Nondegradation Analysis

Under the No Action Alternative, existing DEQ nondegradation policy applies to analysis of wastewater discharges into or proximate to high quality state waters [ARM 17.30.706(1)]. Nondegradation standards for phosphorus and nitrogen are both numeric and narrative [ARM 17.30.715(1)(c), (1)(d), (1)(e), and (1)(g)]. Numeric standards for nitrate are applied at the end of the groundwater mixing zones [ARM 17.30.715(1)(d)]. Numeric standards for phosphorus are applied using a 50-year soil adsorption capacity [ARM 17.30.715(1)(e)]. Narrative standards are applied to surface water by demonstrating that the change will not have a measurable effect on any existing or anticipated use or cause measurable changes in aquatic life or ecological integrity [ARM 17.30.715(1)(g)]. Numeric standards for surface water are applied using “trigger values” as part of the nondegradation analysis as described in Chapter 2.

The nondegradation standards and policies apply whether the activity is regulated by DEQ or another jurisdiction (such as a County Health Department). The DEQ regulates discharges from subdivisions as defined by 76-4-102(16) MCA, but local governments are required to comply with the nondegradation rules for subsurface wastewater treatment systems that are not part of defined subdivisions or defined public wastewater treatment systems. Subsurface wastewater treatment systems that were permitted or authorized by the DEQ prior to April 29, 1993 or were in use prior to April 29, 1993, are not subject to nondegradation regulations [ARM 17.30.702(18)]. As long as the use of the site is unchanged, the site does not have to meet current nondegradation requirements.

As outlined in DEQ’s subsurface wastewater treatment system guidance, a break-through analysis is used to analyze phosphorus impacts to surface water (DEQ 2005a). Break-through is the estimated time for phosphorus in groundwater to reach surface water. Using standard assumptions for phosphorus attenuation in soils, break-through of phosphorus to the nearest high

quality surface water is estimated. DEQ regulations require that any phosphorus introduced into groundwater must reside in the soil and groundwater a minimum of 50 years before it enters the nearest surface water. This residence time is intended to allow for nutrient uptake by soil microbes and other biological activity. If the phosphorus 50-year break-through criterion is satisfied, additional analysis of phosphorus impacts to the surface water would not be required (DEQ 2005a).

If the calculated phosphorus break-through is less than 50 years, the impact to surface water is analyzed by using the dilution equation outlined below (DEQ 2005a). In the analysis, it is normally assumed that 100 percent of the effluent load discharged from the subsurface wastewater treatment system will reach the surface water body. Lower loading percentages may be used if site-specific conditions show more favorable nutrient attenuation. The trigger value determination is made for each individual activity, and is not intended to be applied to cumulative effects of multiple unrelated activities. However, multiple phases of a single development are considered an individual activity (DEQ 2005a).

The dilution equation, as referenced in Appendix P in the subsurface wastewater treatment system guidance, is used to evaluate impacts relative to trigger values for streams and rivers using the 7Q10 stream flow, or 7-day, 10-year low flow of the impacted section of stream (DEQ 2005a).

Dilution Equation:

$$\frac{(Q_D)(C_D) + (Q_L)(C_L)}{Q_D + Q_L} < \text{Trigger Value} = \text{non-significant}$$

Q_D = Effluent flow rate from subsurface wastewater treatment system(s)
C_D = Nitrate or phosphorus concentration in effluent
Q_L = Flow rate into (or out of) surface water (7-day, 10-year low flow; 7Q10)
C_L = Nitrate or phosphorus concentration in surface water (assume zero since increase, not total is important)

The use of this equation is required by DEQ for analysis of the proposed subsurface wastewater treatment system's effect on the quality of adjacent high quality surface waters considered to be hydrologically connected to the groundwater system receiving the effluent. The results of the equation must show that any increase in nutrient concentration, either nitrate or phosphorus, in the surface water is below their respective trigger values [ARM 17.30.715(1)(c)]. This result would indicate a non–significant change in the surface water quality. Appendix A includes a step-by-step example of how this equation was used to determine the nutrient loadings that meet the non-significance criteria for the proposed ORW reach.

When the narrative surface water requirements are used, it may be necessary to collect seasonal water samples to determine the nutrient status of the stream (DEQ 2005a). Narrative standards focus on biological criteria such as algal growth, which creates visual as well as biological effects due to impacts on stream oxygen levels.

Effluent Characteristics

According to the DEQ nondegradation analysis guidance document, a Single Family Equivalent (SFE) produces an average of 200 gallons of effluent per day (gpd) with a range of 150 to over 200 gpd for a typical single family home (DEQ 2005a). Based on the Nicklin (2000a) study of estimated effluent flow in the Big Sky area, estimated effluent rates were adjusted from 200 gpd to an average rate of 153 gpd.

Nitrogen concentration in effluent from a subsurface wastewater treatment system, consisting of a standard septic tank and drainfield, is typically 50 mg/L based on average raw wastewater strength of 60 mg/L, with a 10% reduction in the septic tank and a 7% reduction in the drainfield. The average phosphorus effluent concentration used by the DEQ is 10.6 mg/L (DEQ 2005a).

There are various DEQ acceptable subsurface wastewater treatment systems for nitrate, each offering differing levels of nitrate treatment (DEQ 2005c). The more effective a treatment system is, the lower the overall effluent nitrate concentrations will be. Estimated nitrate effluent concentrations from subsurface wastewater treatment systems vary from 50 mg/L for a standard subsurface wastewater treatment system to 24 mg/L (or less) for a Level 2 system. Currently, there are no DEQ-approved subsurface wastewater treatment systems for the reduction of phosphorus, although proposed systems may be reviewed by DEQ for potential approval (DEQ 2005c).

A standard subsurface wastewater treatment system produces nutrient loading of 6.44 lbs of phosphorus and 30.5 lbs of nitrate (as N) per year for each SFE, using the DEQ default effluent flow rate of 200 gpd for a subsurface wastewater treatment system, and default concentration values of 10.6 mg/L for phosphorus and 50 mg/L for nitrogen. Using the effluent flow rate of 153 gpd estimated by Nicklin (2000a) in the Big Sky area, nutrient loading is reduced to 4.93 lbs of phosphorus per year and 23.33 lbs of nitrate (as N) per year for each SFE.

Nutrient loading would be limited by the amount of developable land within the area adjoining the Gallatin River and having a hydrologic connection to the river (Figure 2-1). As shown in Section 4.4.3, there are 1,846 acres of available developable land within the hydrologically connected area, or vulnerability footprint. Under maximum development allowed by current zoning, 652 single family dwellings could be built on currently undeveloped or partially developed lands (Table 4.4-3).

For this analysis, it was assumed that each residence would be equal to one SFE. An SFE is defined as a relative measure of demand placed on the water and wastewater treatment plant by an average single-family residential unit. For our analyses, one SFE has two bedrooms and two bathrooms. Using the maximum number of SFEs possible in the vulnerability footprint area, the corresponding total nutrient loading to the Gallatin River was projected to be 3,212.14 lbs of phosphorus and 15,212.79 lbs of nitrate (as N) per year. The analysis does not account for attenuation of nitrate or phosphorus in soils or groundwater and assumes 100% of the effluent loads discharged from the subsurface wastewater treatment systems would reach the Gallatin River, which is in conformance with the DEQ surface water calculation requirements (DEQ 2005a). When translated to a unit-area basis, average loading rates of 1.74 lbs of phosphorus/acre and 8.24 lbs of nitrogen/acre were determined for the No Action Alternative.

Using monthly mean flows from the Gallatin River gauging station for at least 67 years of record, flows from October (447 cfs), February (299 cfs), June (2,910 cfs), and July (1,270 cfs) were used to predict average seasonal concentrations of nutrients given the above nutrient loads (McCarthy 2005). These monthly mean flows were chosen based on seasonal low and high flow rates and significance to aquatic life (Figure 4.3-1).

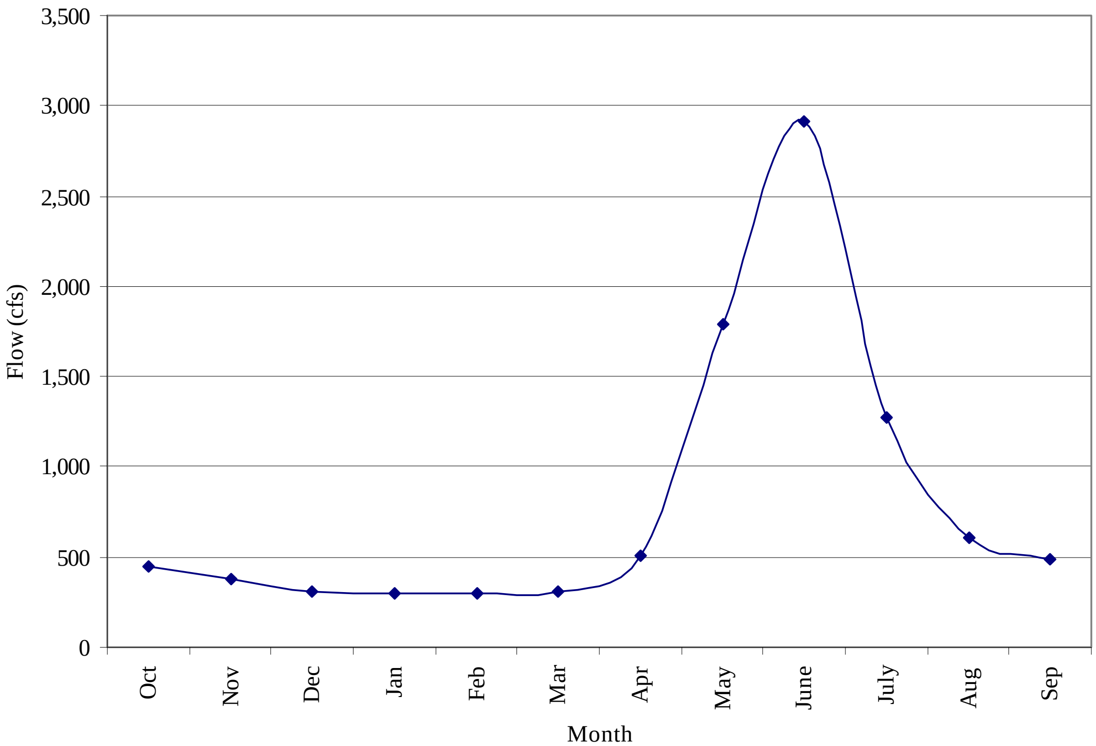

Figure 4.3-1. Mean monthly flows as measured at USGS Station 06043500, near Gallatin Gateway, Montana, from 1938 to 2005 (USGS 2006a). Data are displayed to show the water year (measured from October to September) rather than the calendar year.

While the nutrient loads released from a source are assumed to be generally consistent throughout the year, the concentrations within the receiving stream can vary substantially, primarily because of differences in biological activity and water quantity available for dilution in the receiving water. Greater biological activity generally occurs during spring and summer months; these are also the times of highest water flows, causing dilution of the nutrient loads. Therefore, the highest predicted nutrient concentrations occur in October through March, during periods of low flow and very low rates of biological assimilation. Using the previously described loading per SFE and the mean monthly flows in Figure 4.3-1, the phosphorus trigger value of 0.001 mg/L is exceeded in February with approximately 119 new SFEs or greater in the footprint (Figure 4.3-2). Using the same data sets, the nitrate trigger value of 0.01 mg/L is exceeded in February with approximately 252 new SFEs or greater in the footprint (Figure 4.3-3). These values coincide with lower seasonal flow of the Gallatin River and limited biological assimilation of phosphorus and nitrate. Lower flows reduce the dilution of nutrient loads;

therefore, it takes substantially fewer SFEs in the footprint to meet the trigger values at the 7Q10 of 204 cfs (Figures 4.3-2 and 4.3-3).

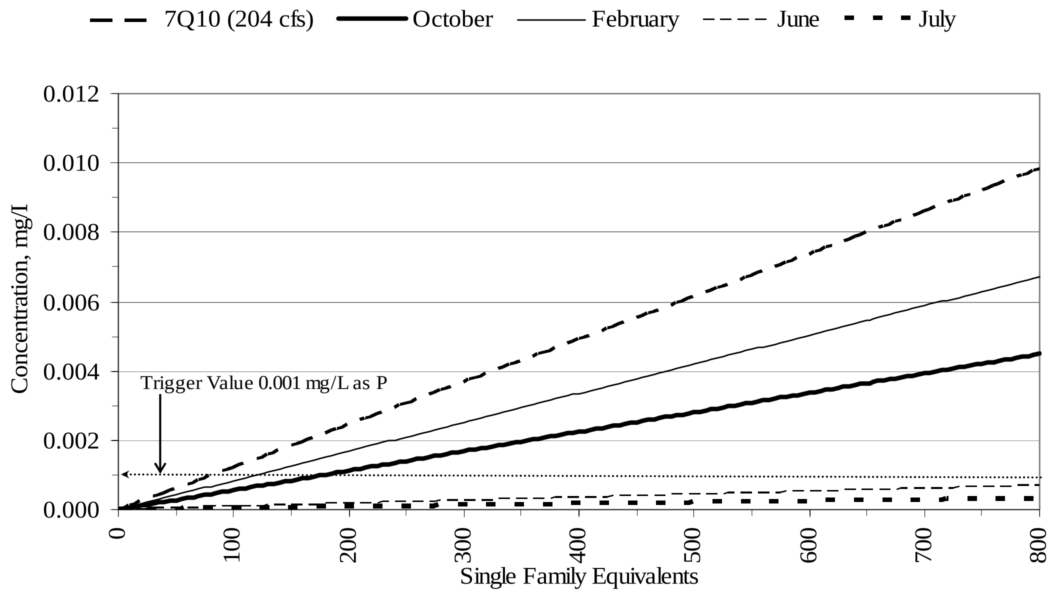

Figure 4.3-2. Predicted phosphorus concentration for No Action Alternative shown in relation to water quality standards trigger value of 0.001 mg/L in the mainstem of the Gallatin River. Plotted concentrations are based on calculated phosphorus loading and dilution, based on mean monthly flows as measured at USGS Station 06043500, near Gallatin Gateway, Montana.

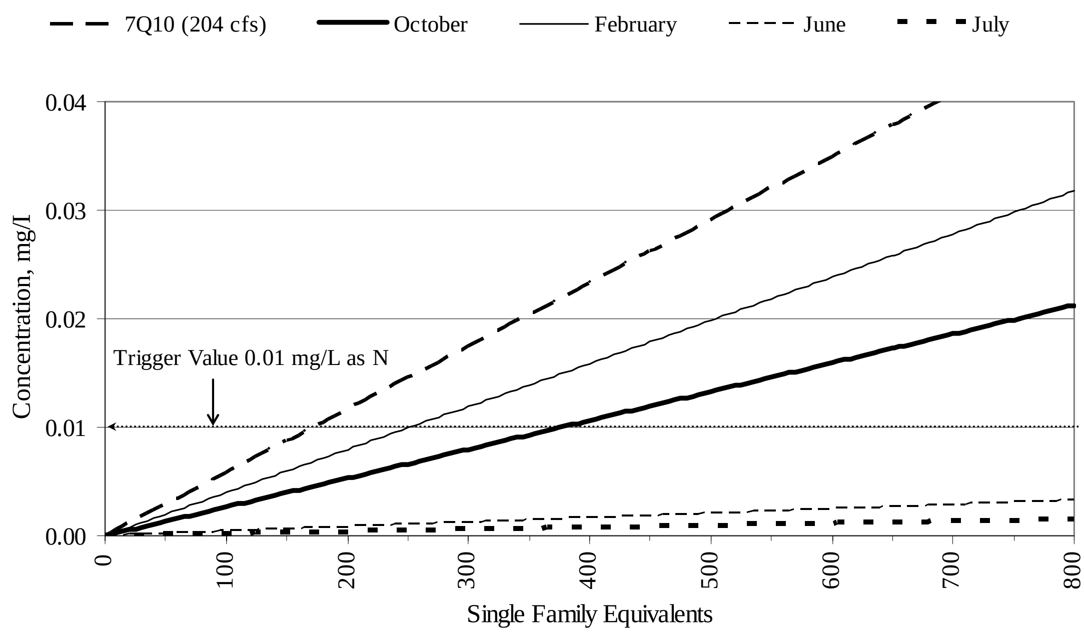

Figure 4.3-3. Predicted nitrate (as N) concentration for No Action Alternative shown in relation to water quality standards trigger value of 0.01 mg/L in the mainstem of the Gallatin River. Plotted

concentrations are based on calculated nitrate loading and dilution, based on mean monthly flows as measured at USGS Station 06043500, near Gallatin Gateway, Montana.

4.3.1.1 Primary Impacts

Primary impacts to water quality from the No Action Alternative include additional potential nutrient loading to the Gallatin River mainstem from future build-out on the 1,846 acres of undeveloped or partially developed land in the study area. This land is hydrologically connected to the proposed ORW reach of the river and therefore within the vulnerability footprint. Current nondegradation analysis evaluates sources adjacent to surface water, but does not rely on a basin-wide hydrologic "vulnerability footprint" approach. The determination of whether a regulated source requires surface water impact analysis is based on whatever information is available to DEQ regarding potential direct hydrologic connection to the surface water. For wastewater sources that are considered adjacent to surface water, analysis of surface water impacts would be required for nitrogen, and also for phosphorus if the 50-year breakthrough requirement is not met. The impacts analysis is based on the trigger values, and if the trigger values are exceeded in the evaluation, under the No Action Alternative, the applicant would have the option of trying to demonstrate compliance with the narrative standard for nitrogen and phosphorus. This narrative method of compliance evaluation would not be available to an applicant under the Proposed Action Alternative. The option of requesting an application to degrade state waters, which is available under the No Action Alternative, would not be available under the Proposed Action Alternative.

Based on the estimate of 652 units determined in the land use analysis (Section 4.4.2) to be the maximum number of developable dwellings, evaluation of the maximum loading to the Gallatin River indicates an increase in phosphorus concentrations of 0.0081 mg/L, which is over eight times the trigger value or measurable change of 0.001 mg/L at the 7Q10 low flow conditions (204 cfs) on the Gallatin River at the gauging station (Figure 4.3-4) (McCarthy 2005). Nitrate (as N) shows an increase of 0.038 mg/L which is almost four times the trigger value of 0.01 mg/L at the same low flow condition and location (Figure 4.3-5).

This evaluation indicates that the No Action Alternative could result in a measurable change in water quality using the development assumptions described in Section 4.4.2. Based on the Gallatin River monthly mean stream flows at the gauging station near Gallatin Gateway, the highest concentrations occur during the winter months when low flow rates limit dilution. Seasonal water quality data collected by the Blue Water Task Force confirm this by showing that the highest seasonal levels of nitrate occur between September and March (BWTF 2006) (Figure 4.3-6).

During winter months, natural nutrient attenuation from biological activity would be limited due to seasonally low temperature and sunlight. Figure 4.3-6 illustrates that the nitrate concentrations in the Gallatin River during winter months are as much as three times higher below the confluence with the West Fork as they are above the confluence. The sources of nitrate in the West Fork have not been specifically quantified, but their combined effect indicates that the magnitude of impact on nitrate concentration in the Gallatin River varies from minimal to substantial depending on the season.

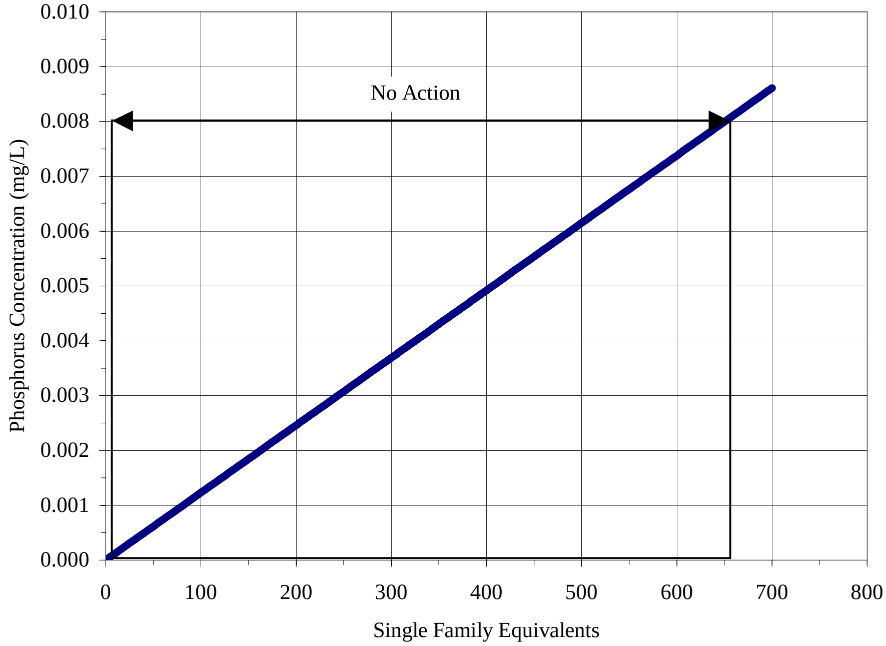

Figure 4.3-4. Predicted phosphorus concentration above background levels (existing levels under current conditions) in the Gallatin River in relation to the number of single family equivalents (SFE).

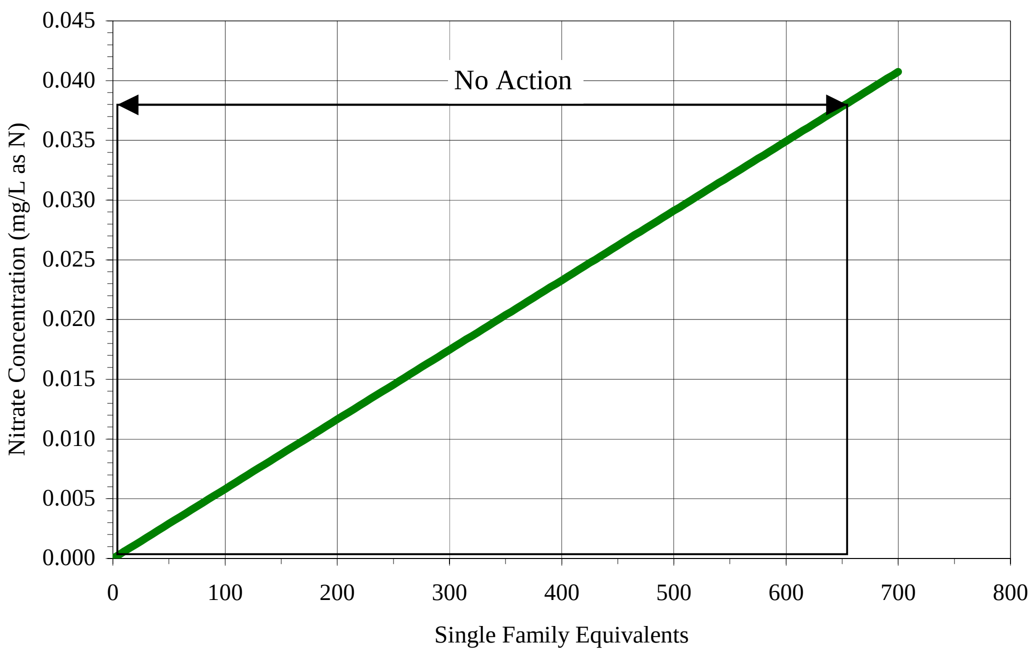

Figure 4.3-5. Predicted nitrate concentration above background levels in the Gallatin River in relation to the number of single family equivalents (SFE).

As outlined earlier, DEQ's subsurface wastewater treatment system guidance uses a break-through analysis to analyze phosphorus impacts to surface water. The DEQ requirement limits break-through to surface water to greater than 50 years. If the phosphorus 50-year break-through criterion is satisfied, additional analysis of phosphorus impacts to the surface water would not be required (DEQ 2005a). Using the nondegradation analysis approach of the No Action Alternative, if the 50-year break-through criterion is met (i.e., not exceeded), evaluation of phosphorus impacts to surface water is not required.

Using the 50-year break-through criterion, a measurable change for phosphorus may occur in the future, albeit likely at least 50 years or more from the initial discharge to groundwater in the vulnerability footprint. This lack of long-term evaluation of impacts to surface water would result in long-term potential increase of phosphorus to the Gallatin River.

Because current DEQ policy evaluates impacts to surface water on the basis of individual development proposals (including serial projects by the same applicant), cumulative effects from multiple independent proposed developments would not be evaluated in a regulatory framework under the No Action Alternative. If nondegradation limits for nutrients cannot be met in groundwater prior to effluent reaching the surface water (in this case, the Gallatin River mainstem), a mixing zone in the river can be adopted so long as DEQ standards are met in the river mixing zone. By using a mixing zone within the Gallatin River mainstem for attenuation of nutrients, there may be localized stretches in the mainstem with elevated levels of nutrients until attenuation would reduce these levels below a measurable change. The result would be a potentially measurable increase in nutrient concentration in the receiving water, which locally may exceed trigger values of these nutrients. Thus, the No Action Alternative could lead to the permitting of subsurface wastewater treatment systems that rely on a mixing zone in the Gallatin River for compliance. Given the data portrayed in Figure 4.3-2 and 4.3-3, it is highly likely that the trigger values for nitrate and phosphorus would be exceeded well before full build-out is reached in the vulnerability footprint.

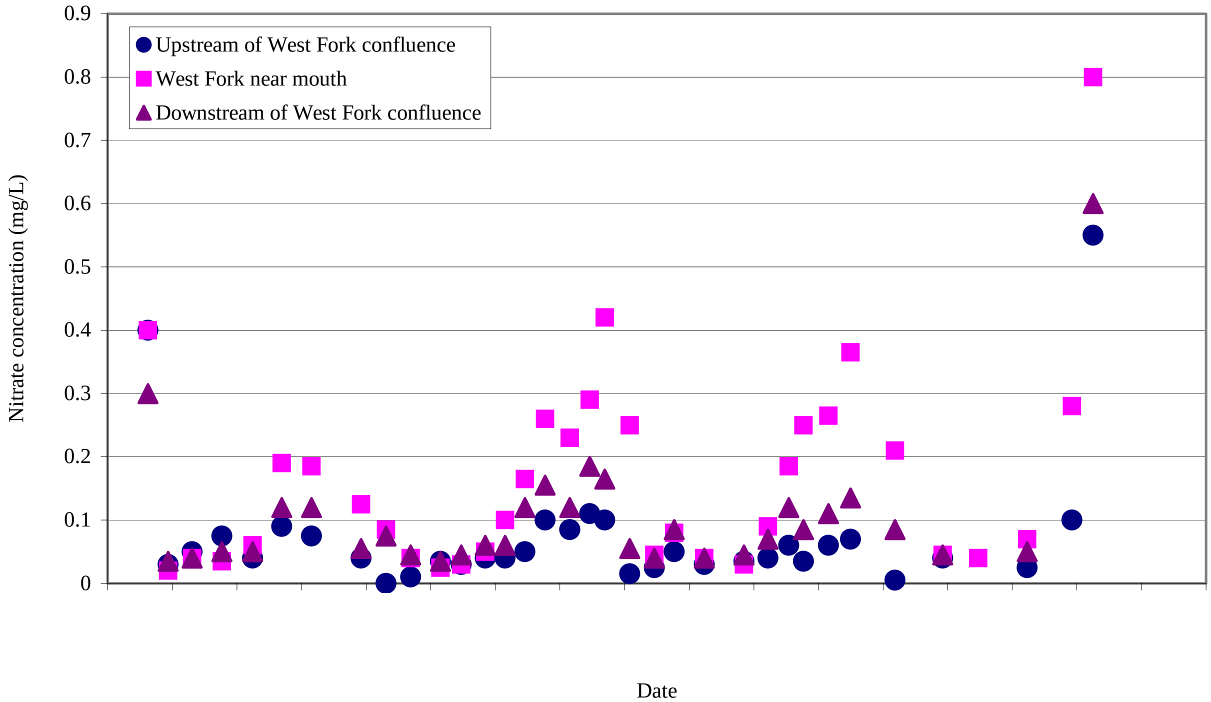

Figure 4.3-6. Nitrate concentrations as measured at three stations near the confluence of the West Fork of the Gallatin River and the Gallatin River near Big Sky, Montana, from April 2000 to January 2004 (BWTF 2006).

Sources of wastewater discharge that are not regulated by the federal, state or local agencies, are not addressed in the No Action Alternative. Under the No Action Alternative, cumulative degradation from these sources as well as other permissible nonpoint sources may degrade water quality.

Sites with subsurface wastewater treatment systems that were permitted or authorized by DEQ prior to April 29, 1993, or were in use prior to April 29, 1993, are not subject to nondegradation regulations [ARM 17.30.702(18)]. As long as the use of the site is unchanged, the site does not have to meet current nondegradation requirements.

4.3.1.2 Secondary Impacts

The Blue Water Task Force sampled and compiled water quality data on the Gallatin River and its tributaries from May 2000 to February 2004. Current water quality data showed that nitrate levels in the West Fork of the Gallatin River were higher than any measured at upstream stations on the Gallatin River mainstem above the confluence with the West Fork of the Gallatin River (BWTF 2006). This higher level of nutrients in the West Fork of the Gallatin River (which drains Big Sky) suggests that, even with much of the West Fork valley served by a municipal sewer system, the intensity of development such as seen in Big Sky has lead to measurable nutrient increases in principal receiving streams.

Other types of unregulated development may lead to measurable nutrient increases in receiving streams, including landscape fertilizer runoff, livestock associated with the recreation industry, release of soil nutrients from timber clearing, increased storm water runoff, or general soil disturbance. Such impacts may occur independent of nutrients from subsurface wastewater treatment systems and serve as secondary impacts from the No Action Alternative. The primary negative impacts on surface water quality caused by increased nutrient loads also result in secondary impacts by enhancing algal and periphyton growth within the streams (Section 4.6). Modeling data in support of a nonsignificance determination performed by Nicklin using the EPA Enhanced Stream Water Quality Model (QUAL2E) have shown a potential increase in algae concentration along the South Fork and West Fork of the Gallatin River as a result of the proposed Yellowstone Mountain Club development (Nicklin 2000b). QUAL2E is a comprehensive and versatile one-dimensional stream water quality model. It simulates the major reactions of nutrient cycles, algal production, and oxygen demand, and their effects on the dissolved oxygen balance.

Estimated algae growth as a result of new developments in the West and South Fork areas of the Gallatin River has shown an increase as high as 3.1% in algal growth at the mouth of South Fork due to increases in nitrate loading to surface waters (Nicklin 2000b).

4.3.1.3 Cumulative Impacts

Cumulative impacts to the Gallatin River related to the No Action Alternative would primarily be those from regulated and nonregulated sources which contribute nutrients. Other cumulative impacts could come from possible increases in sediment loading due to the projected levels of development on undeveloped and partially developed private land, as discussed above. Expansion of residential development in Big Sky will likely increase the service connections to the Big Sky Water and Sewer District. This increased service could lead to more nutrient loading in the Gallatin River if the District chooses to use its MPDES flow-based discharge permit. As indicated in the previous section, it is likely that cumulative impacts of regulated and nonregulated development would lead to measurable increases in pollutant levels in the Gallatin River.

4.3.1.4 Mitigation

Mitigation measures for the No Action Alternative might include the following:

- Requiring automatic surface water nondegradation reviews for all sites within the vulnerability footprint map by DEQ in its routine subdivision review process
- Periodic compliance testing of septic systems to evaluate system efficiency or as part of property transactions with penalties for exceedances
- Higher treatment standards for regulated sources of nutrients for future developments
- Replacement of failing septic systems as required by the County
- More frequent and mandatory pumping of septic systems
- Increased minimum lot sizes
- Community wastewater treatment systems for all new subdivisions

- Alternative septic systems that offer greater degree of treatment (see mitigation under Section 4.3.2)

4.3.2 Proposed Action Alternative

The ORW designation would prevent permanent, measurable change of water quality in the designated reach of the Gallatin due to a new or increased point source discharge to the river. Thus, for undeveloped parcels that are in proximity to the Gallatin River or have a hydrologic connection to the river (as indicated in the vulnerability footprint map [Figure 2-1]), the ORW designation would limit the amount of phosphorus and nitrogen entering the river. The degree of nutrient reduction was determined by applying the subsurface wastewater treatment system dilution equation (see section 4.3.1) on an overall, cumulative basis for both nitrogen and phosphorus. Nitrogen and phosphorus were assumed to be at their respective trigger values at the end of the ORW designated reach near the Gallatin Gateway USGS gauging station at its annual 7Q10 flow. Because effluent from drainfields is discharged year round and its travel time to reach the receiving water varies, the annual 7Q10 value was used as opposed to monthly 7Q10 values. The analysis does not account for any attenuation of nitrate or phosphorus in the soils or groundwater and uses a mass balance and dilution concentration approach. This approach takes the pounds of nutrient in a given period of time and divides it by the volume of flow in that same time period as it intersects the Gallatin River to obtain a total in-stream concentration increase as the nutrient load is diluted by the flow of the river. This is consistent with the application of the vulnerability footprint map, which includes land underlain by high-permeability aquifers with an estimated one-year or less time of travel to the river (Appendix F. of the Footprint delineation methods).

Flow data for the Gallatin River were obtained from USGS statistical summaries of streamflow for the Gallatin River near Gallatin Gateway, Montana (USGS 2006a). The gauging station is approximately 0.3 mile downstream from the Spanish Creek confluence. An annual 7Q10 value of 204 cubic feet per second (cfs) was reported (McCarthy 2005).

For this analysis, the trigger value is the allowable increase above the background value of a pollutant in surface water and is considered the threshold of “measurable change” when evaluating potential impacts under the Proposed Action Alternative. Nutrient loading thresholds for the respective trigger values were calculated for nitrates (as N) and phosphorus (DEQ 2006a) using values of 0.01 mg/L nitrate as N and 0.001 mg/L phosphorus (DEQ 2006a) and the annual 7Q10 value at Gallatin Gateway USGS gauging station of 204 cfs. The annual nutrient loading to the Gallatin River which would cause an in-stream increase equal to the trigger value is 400.78 lbs of phosphorus per year and 4,007.80 lbs of nitrogen per year (Figure 4.3-7 and 4.3-8).

In order to project development in the Spanish Creek and state lands under the Proposed Action Alternative, these areas were considered developed at their threshold limits (see Section 4.4.3 for rationale). Spanish Creek and the state lands have developable land within the vulnerability footprint equivalent to 10 SFEs and 4 SFEs, respectively. Fourteen SFE is substantially less than the maximum density that could be built on the acreages if they were privately held. This constraint of a total of 14 SFEs was subtracted from the nutrient loading shown in the previous

paragraph for the Gallatin River based on 4.93 lbs phosphorus per SFE and 23.33 lbs nitrogen per SFE and yielded the following:

400.78 lbs P – (14 SFE x 4.93 lbs P/SFE) = 331.76 lbs phosphorus
4,007.80 lbs N – (14 SFE x 23.33 lbs nitrogen per N/SFE) = 3,681.18 lbs nitrogen

Based on the given nutrient loading constraints and methods, phosphorus is the limiting nutrient that will first meet the trigger value for measurable change in water quality in the Gallatin River due to discharges from subsurface wastewater treatment systems.

Based on the 1,846 acres of developable land excluding the Spanish Creek and state lands within the vulnerability footprint, the calculated loading for phosphorus is 0.22 lbs/yr/acre and 2.17 lbs/yr/acre for nitrate (as N) in order to stay below the state's trigger values (i.e., measurable change) for these nutrients. (See Appendix A for further explanation of these calculations).

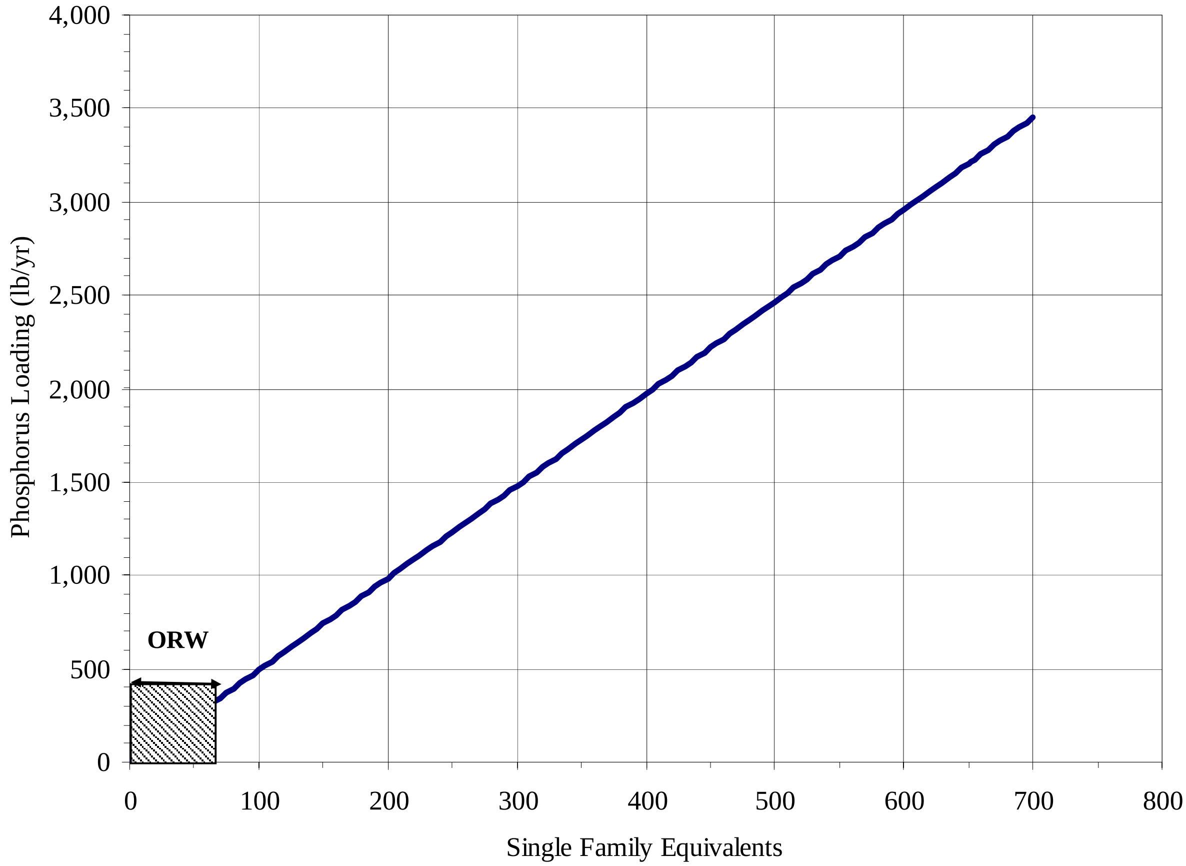

Figure 4.3-7. Projected phosphorus loading to the Gallatin River above background levels based on 4.93 pounds of phosphorus per year per single family equivalent.

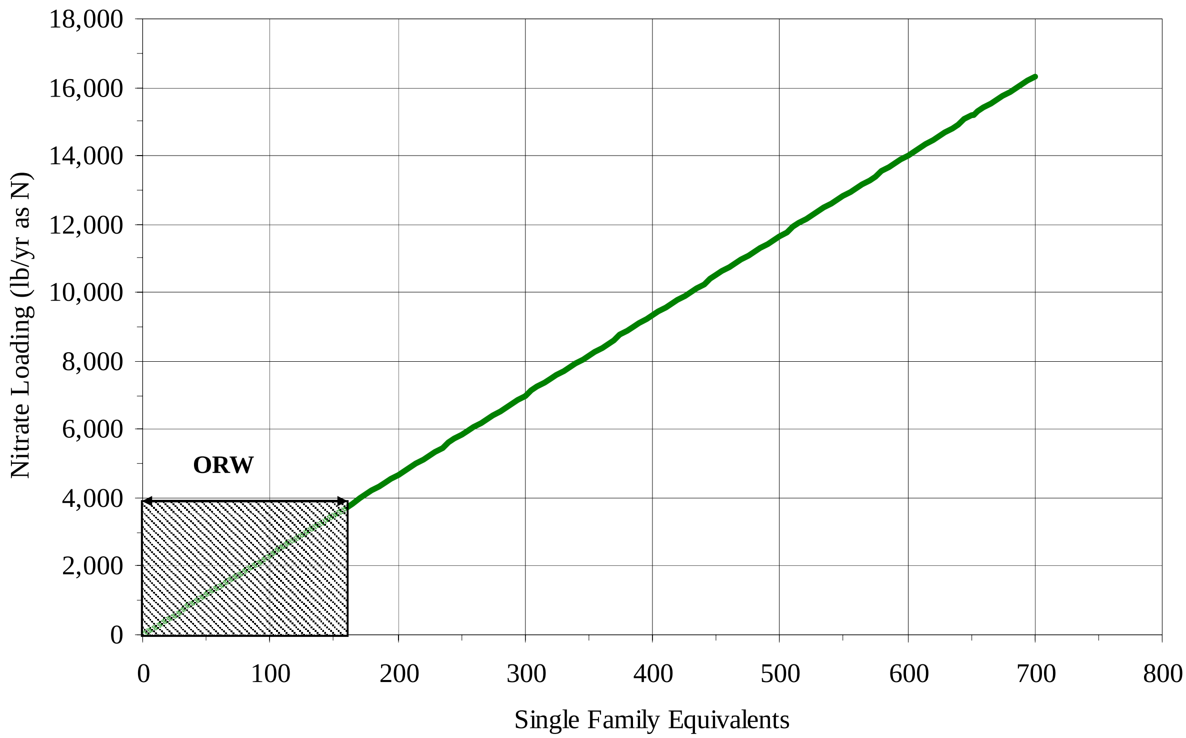

Figure 4.3-8. Projected nitrate loading to the Gallatin River above background levels based on 23.33 pounds of nitrate per year per single family equivalent.

4.3.2.1 Primary Impacts

Primary impacts based on the Proposed Action Alternative would include limiting the nutrient loading based on a nutrient allocation per acre in order to meet no measurable change for nitrate and phosphorus in the Gallatin River, as illustrated in Figures 4.3-7 and 4.3-8 above. To meet the trigger values or no measurable change criteria at the annual 7Q10 low flow of the Gallatin River near Gallatin Gateway, the allowable annual total nutrient loading would be 331.76 lbs phosphorus and 3,681.18 lbs nitrate (as N). This is the maximum allowable annual load from all point sources in the footprint area that would not exceed the trigger values.

Effluent flow rates for subsurface wastewater treatment systems and their associated loading of nutrients is based on 153 gallons of wastewater per day for each SFE (Nicklin 2000a). Based on this estimate flow per SFE and the allowable annual total nutrient loading for phosphorus presented above, approximately 67 SFEs using conventional subsurface wastewater treatment systems placed within the vulnerability footprint would meet the allowable phosphorus limit of 330 lbs phosphorus per year. The Proposed Action would restrict the total contribution of nutrients to the Gallatin River to avoid exceeding trigger values. Because the actual nutrient loading is of concern and not the number of contribution sources, these restrictions would most likely be based on nutrient loading to the Gallatin River from the subsurface wastewater treatment systems, and would not be based on the number of SFEs. The SFE basis is used only as a way to relate actual nutrient loading to a household unit basis.

The Proposed Action Alternative does account for cumulative effects of subsurface wastewater treatment systems by limiting the total nutrient loading under low flow conditions to below any measurable change, in this case, the trigger value for phosphorus, which is more restrictive than the trigger value for nitrogen. However, the Proposed Action Alternative does not account for nonregulated sources, or those sources not restricted under the ORW designation (such as non-point sources to the river and temporary sources). Those sources could degrade water quality to the same degree as under the No Action Alternative.

If a regulated site, with a subsurface wastewater treatment system permitted or authorized by the DEQ prior to April 29, 1993 or in use before April 29, 1993, is changed in a way that could increase discharges to the Gallatin River, it would have to meet the same measurable change requirement as a new subsurface wastewater treatment system under the Proposed Action Alternative.

4.3.2.2 Secondary Impacts

Due to the restriction of nutrient loading to the Gallatin River from subsurface wastewater treatment systems, a developer may seek to place septic system drainfields outside the vulnerability footprint area, even when the development lies within the footprint. This placement may concentrate drainfields from new developments adjacent to the footprint boundary, potentially impacting other groundwater sources due to the spatial limits put on drainfield locations. In addition, new development may be forced outside of the footprint. However, zoning regulations would continue to limit development in all areas, regardless of the alternative chosen. Development in areas of greater topographic relief may lead to increased erosion and sediment transport to tributary drainages and thus eventual transport of increased sediment into the ORW.

The limitation of nutrient level increases to below the trigger value in the proposed ORW reach would limit the proliferation of periphyton and nuisance algae that may occur under the No Action Alternative.

4.3.2.3 Cumulative Impacts

Cumulative impacts to water quality of the Gallatin River due to the Proposed Action Alternative would be less than from the No Action Alternative, since pollution from ORW-affected sources of nutrients would be capped by the no measurable change criteria discussed above. There would still be some cumulative impacts of increased nutrient loading in the ORW. This increased nutrient loading would come from sources of nutrients that are not affected by the Proposed Action Alternative, such as individual septic systems outside the footprint and incidental sources introduced from tributaries.

As discussed in Section 4.3.1, the Proposed Action Alternative could encourage the use of community or regional wastewater treatment systems and ultimately lead to development that is as dense or denser (if community wastewater systems allow changes in zoning for increased density) than under the No Action Alternative. Therefore, other non-wastewater pollutant sources related to development may not be decreased under the Proposed Action Alternative as compared to the No Action Alternative.

4.3.2.4 Mitigation

Phosphorus is the limiting nutrient in subsurface wastewater treatment systems because its trigger value is so much lower than that for nitrogen. Three types of treatment systems were evaluated as mitigation measures to limit phosphorus loading in the ORW. They are described as advanced subsurface wastewater treatment systems, zero discharge systems, and centralized treatment (Table 4.3-1).

Table 4.3-1. Wastewater treatment options for reducing nutrient content of effluent reaching the mainstem of the Gallatin River. (See Appendix G for a more detailed explanation of each method and references).

Treatment system		Phosphorus reduction[a] (%)	Nitrogen reduction[a] (%)	Average cost per single family equivalent[b]	30-year averaged cost (maintenance, etc.)[b]
Conventional subsurface system					
	Septic tank + Drainfield	9	17		
Advanced subsurface options					
A	Recirculating sand filter + drainfield	30	45-75	$16,000 to $22,000	$17,000 to $20,000
B	Chemical removal	50	25	$12,500	---
C	Composting toilet	59	78	$3,200 to $12,800	$13,000 to $22,000
	Incinerator	59	78	$3,200	$40,000
	Recirculating trickling filter + drainfield[c]	18-23	78	$15,000	$27,663
Zero discharge options					
	Off-site disposal	100	100		variable
Centralized treatment options					
	Non-discharge[d]	90-99	90-99	$3,500	variable
	Controlled [e]	Permit written to meet trigger value	Permit written to meet trigger value	---	---

[a] These reductions assume that the manufacturer of the system can provide adequate data to DEQ to meet the nutrient reduction requirements in ARM 17.30.718

[b]Assumes 2 bathrooms with one unit per bathroom. Divide costs by 2 for per unit cost.

[c] Recirculating Trickling Filter only, the Avg Cost/SFE is $9,000, and NPV 6% ROR is $20,902.

[d]Upland spreading and/or open space irrigation after primary treatment. This is similar to current practice of the Big Sky Water and Sewer District.

[e]Controlled hydrograph release discharge - Using Big Sky Water and Sewer District's approved MPDES permit to the Gallatin for seasonal (high river flow) discharge.

Using advanced subsurface treatment options as a mitigation measure would increase the treatment level of effluent over that of a conventional subsurface wastewater treatment system (septic tank and drainfield) and would reduce nutrient loading (Figures 4.3-9 and 4.3-10).

These systems may include recirculating sand filters, chemical removal, incineration, or composting toilets. Recirculating sand filters (Option A) increase treatment of phosphorus from the 9% reduction found in conventional subsurface wastewater treatment systems to a 30% reduction before the wastewater is introduced into the groundwater (EPA 2002). Nitrogen output

is reduced from 17% found in conventional subsurface wastewater treatment systems to 45-75%. The second option uses chemical precipitation (Option B) and reduces phosphorus an average of 50% but has no significant increased effect on nitrogen reduction, which would still be about 17% as found in a conventional subsurface wastewater treatment system. The final option uses a composting or incinerator toilet (Option C), which treats only the water from toilets, known as black water, although a small drainfield is still required for gray water disposal, or water from sinks and other drains which don't originate from toilets. It has a reduction efficiency of 59% for phosphorus and 78% for nitrogen (HydroSolutions 2006). Figures 4.3-9 and 4.3-10 display how these alternative systems (Table 4.3-1) compare with the conventional subsurface wastewater treatment system in terms of total output to the mainstem of the Gallatin River as the number of SFEs increases.

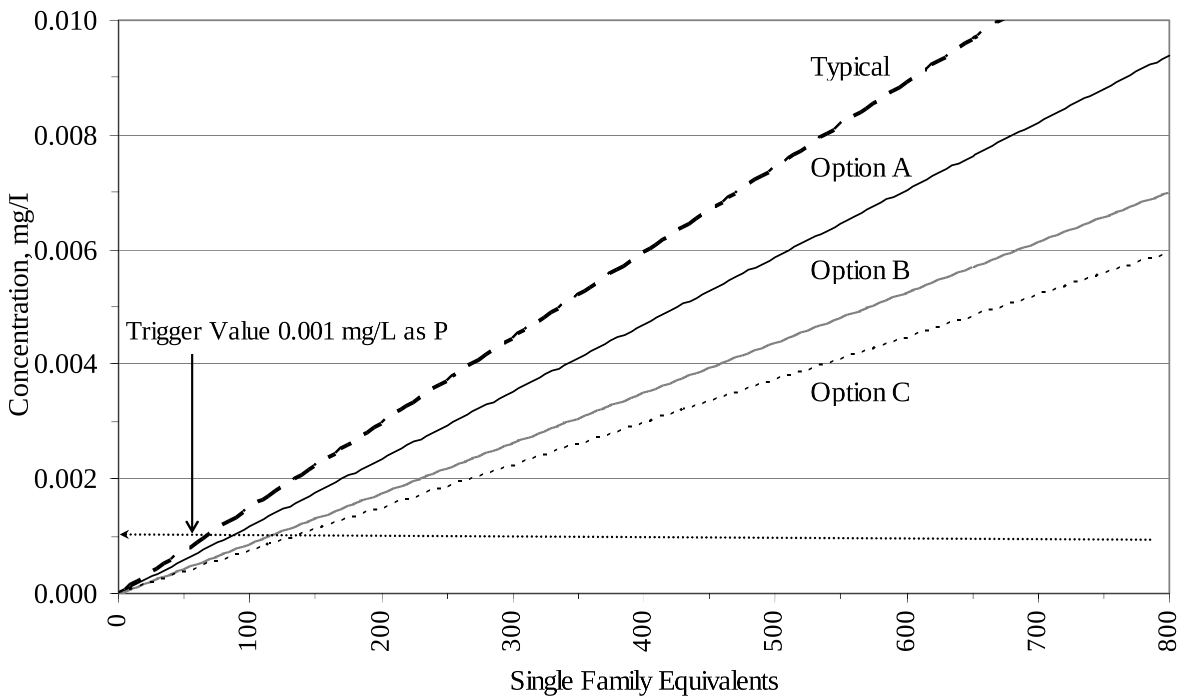

Figure 4.3-9. Predicted phosphorus (as P) concentration resulting from typical septic treatment, and three mitigation options (see Table 4.3-1). Concentrations are shown in relation to water quality standards trigger value of 0.001 mg/L in the mainstem of the Gallatin River. Plotted concentrations are based on calculated nitrate loading and dilution based on 7Q10 flows as measured at USGS Station 06043500, near Gallatin Gateway, Montana.

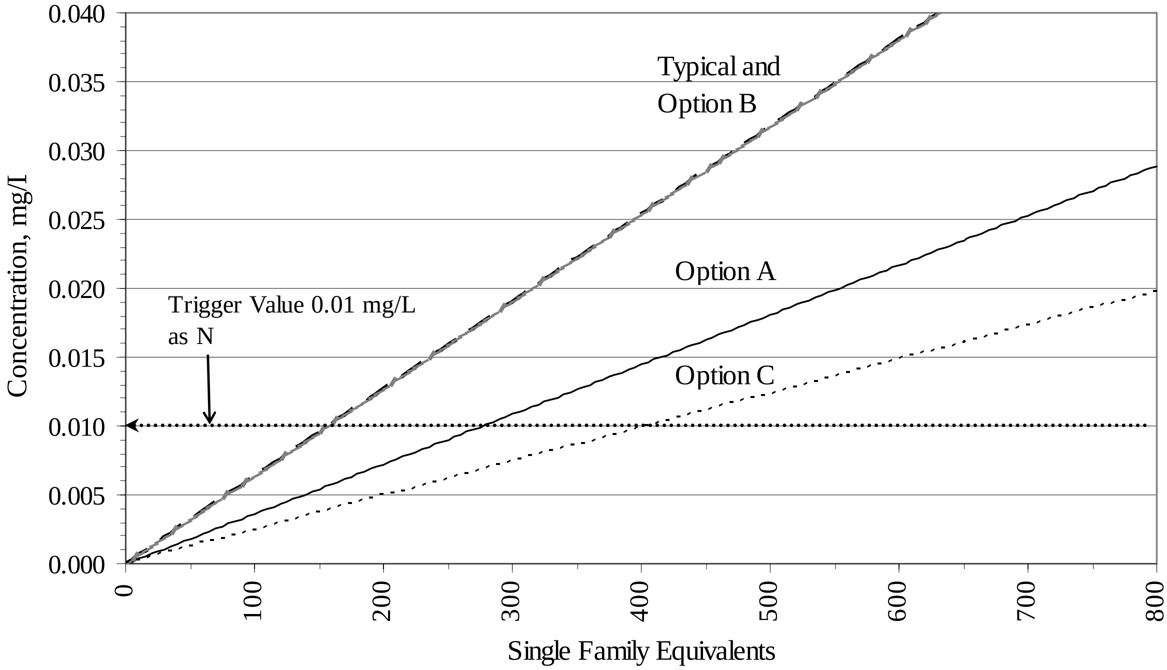

Figure 4.3-10. Predicted nitrate (as N) concentration resulting from typical septic treatment, and three mitigation options (see Table 4.3-1). Concentrations are shown in relation to water quality standards trigger value of 0.01 mg/L in the mainstem of the Gallatin River. Plotted concentrations are based on calculated nitrate loading and dilution based on 7Q10 flows as measured at USGS Station 06043500, near Gallatin Gateway, Montana.

The zero discharge mitigation measure includes on-site storage of the septage in sealed vaults with off-site disposal ultimately outside of the Gallatin River watershed. Thus, the zero discharge measure would result in no increase in phosphorus or nitrate in the ORW.

The final mitigation measure includes centralized treatment. The treatment would rely on using the existing publicly owned treatment works of the Big Sky Water and Sewer District No. 363. Currently, the Big Sky Water and Sewer District land applies its treated effluent to golf courses in the Meadow Village area of Big Sky (R. Edwards, pers. comm. 2006). It is not known if the Big Sky Water and Sewer District has made an allocation of the treatment capacity which could potentially be assigned to additional new development within the vulnerability footprint identified in this study.

The Big Sky County Water and Sewer District also has an MPDES permit (MPDES Permit No. MT-0030384) for seasonal point source discharge to the Gallatin River mainstem just below the confluence with the West Fork, but that discharge point has not been used to date (R. Edwards, pers. comm. 2006). The effluent limitations for the Gallatin River discharge outfall (the point where the treated effluent is discharged to the receiving water) are based on higher monthly 7Q10 flows in the receiving water, from March through June. Most of the discharge is permitted

to occur in May and June, upon meeting applicable water quality standards for phosphorus and nitrogen (ARM 17.30.715(1)(c)).

Based on permit effluent limitations of a 500:1 dilution ratio, which was the mixing ratio of receiving water to treated effluent calculated to maintain the trigger values for nutrients, the Big Sky Water and Sewer District discharge would result in an increase of up to 506 lbs phosphorus and 5,060 lbs nitrogen to the Gallatin River annually through the District's seasonal discharge. This nutrient loading at the discharge outfall is based on nutrient concentrations after primary treatment, a primary process for treating wastewater that focuses on solids removal.

4.3.3 Cumulative Impacts Analysis Alternative

4.3.3.1 Primary Impacts

Primary impacts to hydrology and water quality as a result of the Cumulative Impacts Analysis Alternative would be similar to those under the Proposed Action Alternative.

Under the Cumulative Impacts Analysis Alternative, developments in the footprint would have to undergo a nondegradation review. The proposed development would first be evaluated with respect to whether its wastewater system, in conjunction with the cumulative impacts of other new developments inside the footprint, would contribute enough phosphorus or nitrogen to ~~hit~~ exceed the trigger level for nutrients in surface water. This trigger value analysis would be identical to that in the Proposed Action Alternative. If the development, with cumulative impacts, exceeded the trigger values for nitrogen or phosphorus, the proponent could evaluate the surface water impacts via the narrative standard (DEQ 2005; ARM 17.30.715(1)(g)) , or the applicant could submit an application to degrade state waters (these two options would not be available under the Proposed Action Plan). If the discharge of phosphorus met the 50-year breakthrough requirement (ARM 17.30.715(1)(e)), then the trigger level analysis would not be required for phosphorus for subdivisions adjacent to state surface waters.

If, and when, the cumulative nutrient loading reached the trigger values, a restriction to nutrient loading would be put in place to maintain phosphorus and nitrogen levels at or below the trigger values in the receiving stream. This loading for phosphorus would occur after the addition of approximately 67 SFEs (See Appendix A). Any additional wastewater discharges in the footprint would be required to show nonsignificance via a narrative analysis or submit an application to degrade state waters.

The Cumulative Impacts Analysis Alternative would provide protection similar to the Proposed Action Alternative, with respect to impacts from subsurface wastewater treatment systems. This comparison of Cumulative Impacts Analysis to the Proposed Action Alternative assumes the Proposed Action Alternative will primarily affect residential and commercial development (which is an assumption based on the lack of other existing discharges that will be affected by the Proposed Action Alternative). Further, it assumes that DEQ will use its discretionary powers to evaluate cumulative impacts in the ORW reach. Due to the administrative (rather than legislative) nature of the Cumulative Impacts Analysis Alternative, DEQ could cease cumulative

impacts analysis, return to current regulatory practices, and the impacts would be more similar to the No Action Alternative.

4.3.3.2 Secondary Impacts

Secondary impacts as a result of the Cumulative Impacts Analysis Alternative would be similar to those under as the Proposed Action Alternative. Unregulated development in lands outside of the footprint may lead to measurable nutrient increases in receiving streams, as indicated in the discussion of the No Action Alternative.

As with the Proposed Action Alternative, the restriction of nutrient loading to the Gallatin River from subsurface wastewater treatment systems may encourage a developer to place septic system drainfields outside the footprint, even when the development lies within the footprint. This placement may concentrate drainfields from new developments adjacent to the footprint boundary, potentially impacting other groundwater sources due to the spatial limits on drainfield locations. In addition, new development may be forced outside the footprint. However, zoning regulations would continue to limit development in all areas, regardless of the alternative chosen. Development in areas of greater topographic relief may lead to increased erosion and sediment transport to tributary drainages and thus eventual transport of increased sediment into the ORW.

The limitation of nutrient level increases to below the trigger value in the Cumulative Impact Analysis Alternative would limit the proliferation of periphyton and nuisance algae to below levels that may occur under the No Action Alternative.

4.3.3.3 Cumulative Impacts

Cumulative impacts to water quality of the Gallatin River due to the Cumulative Impacts Analysis would be similar to those under the Proposed Action Alternative. Pollution from affected sources of nutrients would be capped by the no measurable change criteria discussed above by applying the trigger value evaluation to cumulative impacts from developments. There would still be some cumulative impacts of increased nutrient loading in the study area, and this increased nutrient loading would come from nutrient sources that are not affected by the Cumulative Impacts Analysis Alternative, such as individual septic systems outside of the footprint and incidental sources introduced from tributaries.

As discussed in Section 4.3.1, the Cumulative Impacts Analysis Alternative could encourage the use of community or regional wastewater treatment systems and ultimately lead to development that is as dense or denser (if community wastewater systems allow changes in zoning for increased density) than under the No Action Alternative. Therefore, other non-wastewater pollutant sources related to development may not be decreased under the Cumulative Impacts Analysis Alternative as compared to the No Action Alternative.

4.3.3.4 Mitigation

Mitigation measures for the Cumulative Impacts Analysis Alternative are similar to the Proposed Action Alternative (see section 4.3.2.4)

4.4 Land Use and Recreation

4.4.1 Introduction and Overview

Land Use

As explained in Chapters 2 and 3, the focus of impact analysis (for all alternatives) is on the corridor of land termed the "footprint" along the river and its major tributaries. The lands encompassed by the footprint are illustrated in Figure 1-1, with total acreage in the footprint (in Gallatin County) summarized below in Table 4.4-1.

Table 4.4-1. Acreage of land in the footprint—in Gallatin County.

Ownership/Jurisdiction	Acres
Public Land	
Federal: Gallatin National Forest	11,379
State: Gallatin Wildlife Management Area	869
Subtotal Public Land	**12,248**
Private Land	
Gallatin Canyon/Big Sky Zoning District	3,104
South Gallatin Zoning District	1,226
Spanish Creek-North Karst Area	1,922
Subtotal Private Land	**6,252**
Total Public and Private Land	**18,500**

(Note: Districts listed above in Table 4.4-1 are delineated in Figure 3.4-1)

Potential land use impacts center on the "build-out increment" defined as those public and private lands within the footprint in Gallatin County that are presently undeveloped or partially developed[c] and on which future residential, commercial, industrial, institutional, or recreational developments may be expected based on current plans and/or zoning designations (Appendix H: land use identification and acreage calculation methods). The primary expression of ORW land use impacts is the difference in magnitude of development that would be allowed or expected in the build-out increment under the No Action Alternative versus that under the Proposed Action or the Cumulative Impacts Analysis Alternative. This difference in allowable development is due to the more stringent water quality protection standards and policies under the Proposed Action or the Cumulative Impacts Analysis Alternative compared with existing regulations under the No Action Alternative.

Table 4.4-2 lists the areas of private lands in the footprint and identifies the build-out increment by area for these lands and by planning or zoning designation. It is in the build-out increment, shown in this table, that the primary differences in possible future development are compared between the No Action and two Action alternatives. For public lands, there is no comparable

[c] Partially developed means currently hosting some level of developed land use (such as residential), but at a density/intensity less than that allowed by existing plans and/or zoning designations.

distinction between developed, partially developed, and undeveloped land. Instead, impact analysis focuses on the limited number and type of facilities present or expected on the federal or state lands in the footprint (e.g., recreation sites, recreation residences, operations and maintenance facilities, etc.), and on the relative potential for new facilities or expansions of existing facilities under the No Action, Proposed Action, and Cumulative Impact Analysis alternatives. Table 4.4-2 includes all land use classifications present in the respective zoning districts to allow ease of comparison with Table 3.4-2. The zoning districts analyzed are experiencing rapid development. Some of the acreages shown as undeveloped may include some lands with subdivision approval but no current building activity; however, data necessary to exclude these cases from analysis are not available at this time. Thus, results shown are the most conservative estimates of lands available for development (i.e., indicates the lowest possible numbers of acres available). In addition, Table 4.4-2 includes some lands that have received development approval by Gallatin County but are not constructed. According to Gallatin County policy, such cases are considered "developed." Such projects would be subject to ORW restrictions only if the developer initiates the DEQ water quality permitting process after formal adoption of the ORW designation. If the DEQ permitting process has been initiated before ORW adoption, then the regulations, procedures and criteria in force at the time of application will apply.

Table 4.4-2. Private lands in the footprint, total and build-out increment acreage, by area and land use classification as of February 2006 (see Appendix H for sources and methodology used to compile these data).

Land Use Classification		**Total (acres)**	**Build-Out Increment**		
			Fully Developed (acres)	**Partially Developed[a] (acres)**	**Undeveloped (acres)**
Gallatin Canyon/Big Sky Zoning District[b]					
Residential [c]					
Town Center Residential		--[d]	--	--	--
Multi-Family 3500		40	40	--	--
Multi-Family 3600		--	--	--	--
Mobile Home 6000		--	--	--	--
Single Family 7500		40	0	39	1
Single Family 11000		49	29	7	13
Residential Cluster	1	148	83	18	47
Residential Cluster	2.5	378	188	10	180
Residential Cluster	5	490	157	63	270
Residential Cluster	10	338	137	55	146
Residential Cluster	20	237	29	112	96
Residential Cluster	40	--	--	--	--
Residential Cluster	100	--	--	--	--
Commercial					
Community Commercial		48	41	--	7
Commercial and Industrial Mixed Use		215	197	--	18
Meadow Center		--	--	--	--
Recreational Business		13	10	--	3
Resort		--	--	--	--
Town Center Commercial		--	--	--	--

Table 4.4-2. Private lands in the footprint, total and build-out increment acreage, by area and land use classification as of February 2006 (see Appendix H for sources and methodology used to compile these data).

Land Use Classification	Total (acres)	Build-Out Increment		
		Fully Developed (acres)	Partially Developed[a] (acres)	Undeveloped (acres)
Community Facilities	7	6	--	1
Community Recreation	--	--	--	--
Open Space Preserve	21	21	--	--
Subtotals	2,026	940	304	782
South Gallatin Zoning District				
Canyon Residential	180	37	--	143
Canyon Commercial	117	117	--	--
Recreation and Forestry	920	512	--	408
Subtotals	1,217	666	0	551
Spanish Creek-Karst Area				
Rural Areas	477	268	--	209
Conservation Easements	1,444	--	645	799
Subtotals	1,921	268	645	1,008
Totals	**5,163**	**1,874**	**949**	**2,341**

[a] Partially developed lands in the Gallatin Canyon/Big Sky Zoning District generally are parcels with one dwelling unit but on which zoning classification would allow additional units/higher density; for the conservation easement lands in the Spanish Fork Area, partially developed simply means parcels containing isolated ranch residences or operations/maintenance facilities;
[b] Acreages shown for the Gallatin Canyon/Big Sky Zoning District do not include lands within the Big Sky Water and Sewer District (1,122 acres); lands within this District would not be affected by the proposed ORW designation (see Section 4.3) and are thus excluded from analysis.
[c] Land use classification does not occur within the footprint.
[d] For explanation of terms in this category, see Table 3.4-2.

4.4.2 No Action Alternative

4.4.2.1 Primary Impacts

Land Use

The No Action Alternative would have no effect on existing or planned land use within the footprint or beyond in the larger ORW study area. Development would proceed according to the plans and regulations of the agencies having land use jurisdiction within the footprint. The build-out increment for the Big Sky Water and Sewer District is not included, as full build-out within District boundaries according to the County Zoning Ordinance for the area is anticipated by and included within the District's water quality permit. For the purposes of this analysis, "full build-out" covers all anticipated (by the County Zoning Ordinance/Map) development within the District's boundary. Therefore, the District's permit does not cover full build-out of the Big Sky area; only that part of Big Sky within the District boundary. The development inside the

District's boundary is therefore a constant in all alternatives and not a factor in assessing variability between the No Action, Cumulative Impacts Analysis and Proposed Action alternatives.

Related to public land component, no development of new, or expansions of existing, recreational, residential, operations, or maintenance facilities are currently planned by either the Forest Service or Montana Fish, Wildlife and Parks. Thus, there is no defined build-out increment of development on these public lands. As noted in Section 3.4, the State has no current expansion plans Porcupine Creek facilities. If any such expansion were to be proposed, development would be subject to existing state and county regulations and standards for wastewater management. Under these regulations and standards, use of conventional septic tank/leach field wastewater systems would likely be feasible, and water quality protection overall would not represent a constraint on development. The same is true for any currently unforeseen need or desire by the Forest Service to expand its facilities along the river (e.g., recreation sites).

On private lands within the footprint, development of the build-out increment would proceed according to applicable provisions of the Gallatin County Growth Policy, Zoning Ordinances, and Subdivision Ordinance. Tables 4.4-3 and 4.4-4 provide estimates of the build-out increment under the No Action Alternative, expressed as the allowed or expected number of dwelling units or building square feet, as appropriate, for those land use classifications present in the footprint. Please note that a "dwelling unit" is similar to, but not necessarily equivalent to an SFE. An SFE is defined by the amount of wastewater expected to be generated by a residence or business based on data compiled by agencies (e.g. Water and Sewer Districts, DEQ, etc). In this document a two-bedroom, two-bath residence is one SFE. A dwelling unit can be larger or smaller than an SFE and is based on zoning for an area as well as typical existing developments. In all cases, estimates in the following tables are based on the acres-per-SFE allocations, which assume use of conventional septic tank and drainfield wastewater treatment systems and does not account for the fact that many dwelling units in Big Sky are only occupied seasonally (i.e., one dwelling unit would not necessarily equal one SFE). For example a one bedroom apartment is classed as 0.7 SFE and a four-bedroom, three-bath home is 2.0 SFE although each qualifies as one dwelling unit (WSD 2006a). Dwelling unit types and densities are regulated by zoning, the focus of this section, whereas SFEs are related to water quality regulation.

Table 4.4-3. No Action Alternative—allowable residential development per existing plans and zoning classifications.

Land Use Classification	Density	Total	Unit[a]
Gallatin Canyon/Big Sky Zoning District			
Residential[b]			
Single Family 7500	5.8 DU per acre	226	DU
Single Family 11000	4 DU per acre	67	DU
Residential Cluster 1	1 DU per acre	60	DU
Residential Cluster 2.5	1 DU per 2.5 acres	72	DU
Residential Cluster 5	1 DU per 5 acres	66	DU
Residential Cluster 10	1 DU per 10 acres	15	DU
Residential Cluster 20	1 DU per 20 acres	10	DU
Subtotal		***516***	**DU**
South Gallatin Zoning District			
Canyon Residential	1 DU per 3 acres	48	DU
Recreation and Forestry	1 DU per 50 acres[c]	8	DU
Subtotal		***56***	**DU**
Spanish Fork Area[d]			
Rural Areas	1 DU per 3 acres	70	DU
Conservation Easements	Maximum of 10 Total DU	10	DU
Subtotal		**80**	**DU**
	Total	***652***	**DU**

[a] DU = Dwelling Units.
[b] For explanation of terms in this category, see Table 3.4-2.
[c] Base density is 1 DU per 100 acres; however, 2 DU per 100 acres is allowed if units are clustered on 10% of the site.
[d] Area is not zoned; estimate of average density based on analysis of existing development patterns and densities.

Table 4.4-4. No Action Alternative—allowable commercial development per existing plans and zoning classifications.

Land Use Classification	Density	Total	Unit[a]
Gallatin Canyon/Big Sky Zoning District			
Commercial			
Community Commercial	13,000 SF per acre[b]	91,000	SF
Commercial and Industrial Mixed Use	15,000 SF per acre[c]	270,000	SF
Recreational Business	15,000 SF per acre[c]	45,000	SF
Community Facilities	13,000 SF per acre[c]	13,000	SF
Total		***419,000***	**SF**

[a] SF = Square Feet.
[b] General estimate based on Zoning District parking and open space standards and specified allowed uses for this land use classification. Square footage calculation uses a prototypical FAR (Floor Area Ratio - the ratio of building square footage to site size) of 0.3:1, and assumes two-story structure(s) with half retail uses and half office/service uses.
[c] General estimate based on Zoning District parking and open space standards and specified allowed uses for this land use classification. Square footage calculation uses a prototypical FAR of 0.35:1, and assumes two-story structure(s).

The lands bordering Spanish Creek are not zoned. The conservation easements in this area are primarily on lands that are part of the Turner Flying D Ranch. These easement agreements permit a maximum of ten dwellings to be built on the roughly 107,000-acre ranch. Locations of these dwellings are subject to approval by The Nature Conservancy, the agency which oversees the easement. Again, this limit is a constant in all alternatives and not a factor in assessing differences between the No Action and Proposed Action alternatives.

As shown on Table 4.4-3, current Gallatin County plans and zoning regulations would allow up to 652 additional dwelling units to be built on currently undeveloped or partially developed lands within the footprint (516 in the Gallatin Canyon/Big Sky Zoning District, 56 in the South Gallatin Zoning District, and 80 in the unzoned area from Spanish Creek to Karst). In the Gallatin Canyon/Big Sky Zoning District, in addition to residential units, an estimated 419,000 square feet of commercial and community facilities are also allowed by existing zoning regulations (Table 4.4-4).

No commercial or community facilities components are shown in Table 4.4-4 for the build-out increment in the South Gallatin Zoning District or the unzoned Spanish Creek to Karst area. Given the flexibility of current regulations, this type of development could occur in these areas. Specifically, in the South Gallatin Zoning District, there are no remaining undeveloped lands zoned for commercial or community use, but uses such as guest or dude ranches are allowed in the Recreation and Forestry classification. Insufficient information is available to provide estimates of the potential for this type of use; thus, the allowed residential yield for this zoning classification is used to portray the build-out increment. In the case of the Spanish Creek to Karst area, small commercial businesses (e.g., rafting companies, small motels) are present in the "Rural Areas" designation assigned by the County Growth Policy. It can be expected that the build-out increment on these lands will include similar additional small commercial businesses.

Characterizing the build-out increment as purely residential is considered valid for the purposes of ORW analysis because the character of current developed use is overwhelmingly residential and there is no reason to suspect that this condition will change as growth and development continue. In addition, the small scale of commercial or community uses currently present in the area is probably characteristic of potential future, similar uses, and there is no appreciable difference between such uses and residential development in terms of wastewater management requirements or regulations.

Recreation

The No Action Alternative would have no major primary impacts on recreational uses. Neither the levels nor extent of development anticipated within the ORW footprint under this alternative would impose new constraints on river access or the capacity of the river to accommodate recreational uses. Development of up to 652 new dwelling units in the ORW footprint would represent an increase in the number of recreation users in the area; however, in the context of a resource hosting 40,000 or more recreation user-days annually, this increase would be minor.

4.4.2.2 Secondary Impacts

Land Use

The No Action Alternative would have no secondary impacts on land use within or outside of the ORW study area.

Recreation

Land development along a river corridor, like that anticipated in the No Action Alternative, can have secondary impacts on recreational uses of the river. Specifically:

- Many, if not all, of the recreation activities characteristic of the proposed ORW reach of the Gallatin River are sensitive to water quality changes. This is true of both 1) the aesthetic consequences of water quality degradation, such as turbidity, algae, odor, taste, etc., and 2) quality factors that affect the productivity of the fishery, including temperature, dissolved oxygen content, etc. In the latter regard, fish catch rates and relative size of fish caught are both important factors in angler satisfaction (Duffield et al. 1987, Duffield and Allen 1988); any factors that significantly reduce these parameters will correspondingly reduce use satisfaction; and
- Substantial residential or other forms of development along the river can detract from the scenic quality of the corridor. This perspective is particularly relevant in the ORW study area given that canyon scenery is a major factor influencing recreation use of the Gallatin River (see Section 3.4.3.4).

In the first of these regards, analysis presented in Section 4.7 suggests that the water quality impacts of development in the footprint under the No Action Alternative could result in:

- Adverse fishery impacts within the ORW study area (i.e., by reducing trout growth and the overall carrying capacity of the proposed ORW reach); and

- Adverse aesthetic impacts (e.g., algal blooms) downstream of the ORW reach (within the ORW reach itself, cold water temperatures will tend to minimize such impacts from increased nutrient levels).

To the extent that these secondary water quality impacts occur, they would represent corresponding secondary impacts to the recreational values in, and downstream of, the ORW reach. Within the ORW reach, the main effect of this impact would be on angler satisfaction. Downstream, the impact would affect all recreation uses.

Related to scenic quality, most recreational uses of the river in the ORW study area occur along the reaches within federal and state ownership, not in the privately owned areas where some level of development is already apparent. Further, most, if not all, new development along the proposed ORW reach under the No Action Alternative would be subject to the 300-foot setback requirement specified in Gallatin County's 2005 subdivision regulations. For recreation users along or on the river, this setback requirement significantly reduces the potential for adverse visual quality impacts and/or offers sufficient area for effective mitigation of such impacts. In the latter regard, however, proper application of visual quality protection measures within the 300-foot setback would be the responsibility of County decision makers as part of the development review and approval process.

4.4.2.3 Cumulative Impacts

Land Use

The No Action Alternative would have no adverse cumulative impacts on land use within the ORW footprint or the wider land use/recreation study area.

Recreation

To the extent that water quality impacts from development in the footprint under the No Action Alternative act cumulatively with similar impacts from development outside of the footprint (e.g., the larger Big Sky area), corresponding cumulative secondary impacts to recreation would also occur (i.e., cumulative adverse consequences for fisheries the ORW study area). See Section 4.7.1 for further detail.

4.4.2.4 Mitigation

Land Use

Since the No Action Alternative would have no adverse impacts on land use, no mitigation is necessary.

Recreation

Potential mitigation for the water quality impacts of the No Action Alternative that could result in secondary impacts to recreation are discussed in Sections 4.3.1.4 and 4.7.1.4. To the extent that these measures are implemented and are successful, secondary impacts to recreation would be correspondingly reduced.

4.4.3 Proposed Action Alternative

4.4.3.1 Primary Impacts

Land Use

The Proposed Action, without mitigation, would have primary impacts on land use in the privately owned part of the footprint. These impacts stem from the effective ceiling placed on total, future, and cumulative additions to the phosphorus and nitrogen loads reaching the river from wastewater treatment and disposal systems in the footprint. As discussed in Section 4.3.2, the phosphorus limit is the most restrictive and, by allocating the maximum allowable additional load in the river proportionally, would translate to an allowed development density of one SFE (Single Family Equivalent) per 27.6 acres (assuming conventional septic tank and drainfield wastewater systems). This minimum lot size can be dramatically reduced using the alternative wastewater systems described in Table 4.3-1. The land base used in calculating this allocation is the build-out increment of private acreage within the footprint (partially developed and undeveloped), excluding the conservation easement lands in the Spanish Creek-Karst area, for a total of 1,846 acres (see Table 4.4-2). No allocation is assigned to the National Forest lands in the footprint, and small allocations of the total allowable phosphorus load are assigned "off the top" to accommodate: 1) the maximum of an additional ten dwelling units allowed within the conservation easements (Table 4.4-3), and 2) potential future expansion of Montana Fish, Wildlife and Parks' Porcupine Creek facilities (Section 3.4). See Section 4.3.2 for discussion of the rationale behind these allocation decisions. For National Forest lands, no addition or expansion of water-borne wastewater treatment systems (e.g., septic tank and drainfields) would be allowed within the footprint upon approval of the proposed ORW designation. Any future additions or expansions of toilet facilities at Forest Service recreation sites would be restricted to closed (zero discharge) technologies. Since zero discharge systems (i.e., sealed vault toilets) are currently the de facto standard on Forest Service recreation sites in the footprint, this restriction should not pose a constraint on Forest Service flexibility for future site expansion (T. Keyes, pers. comm. 2006).

For state lands, no current expansion of its Porcupine Creek complex is planned. However, should the state choose to expand this facility in the future, accommodation for this potential is included in the proposed pollutant allocation method described in Section 4.3.2. Therefore, the Proposed Action will not impact or constrain use on state lands.

The major primary impact of the Proposed Action, without mitigation, would be on development potential within the build-out increment of private lands in the footprint. Table 4.4-5 provides estimates of allowable development under the Proposed Action, expressed as the allowed or expected number of dwelling units or building square feet, as appropriate, for those land use classifications present in the footprint. In all cases, these estimates are based on the acres-per-SFE allocation described above, which assumes use of conventional septic tank and drainfield wastewater treatment systems and does not account for the fact that many dwelling units in Big Sky are only occupied seasonally (i.e., each dwelling unit would not necessarily equal one SFE). Given these assumptions, the results shown in Table 4.4-5 represent restrictive limits (See Mitigation, in section 4.4.3.4, below, for assessment of comparable results for alternative

wastewater treatment systems). The projected total of dwelling units (DU) in Table 4.4-5 is slightly lower (75 SFE) than the total number of SFE along the entire proposed ORW reach to meet the trigger value including the 14 SFE allocated to State and conservation easement lands (81 SFE) (Appendix A) because some of the dwelling units represent more than one SFE or are noted as being on partially developed lands where loading was based on the total allowable density.

Table 4.4-5. Proposed Action Alternative - allowable development under ORW designation without mitigation

Land Use Classification	Density[a]	Total	Unit[b]
Gallatin County/Big Sky Zoning District			
Residential[c]			
Single Family 7500	1 DU per 27.6 acres	1	DU
Single Family 11000	"	1	DU
Residential Cluster 1	"	2	DU
Residential Cluster 2.5	"	7	DU
Residential Cluster 5	"	12	DU
Residential Cluster 10	"	7	DU
Residential Cluster 20	"	7	DU
Subtotal Residential		***37***	***DU***
Commercial[d]			
Community Commercial	53 SF per acre[e]	374	SF
Commercial and Industrial Mixed Use	110 SF per acre[f]	1,980	SF
Recreational Business	73 SF per acre[g]	218	SF
Community Facilities	73 SF per acre[h]	73	SF
Subtotal Commercial & Community Facilities		***2,645***	***SF***
South Gallatin Zoning District			
Canyon Residential	1 DU per 27.6 acres	5	DU
Recreation and Forestry	"	15	DU
Subtotal		***20***	***DU***
Spanish Fork Area			
Rural Areas	1 DU per 27.6 acres	8	DU
Conservation Easements	Maximum of 10	10	DU
Subtotal		***18***	***DU***
Total Residential		***75***	***DU***
Total Commercial & Community Facilities		***2,645***	***SF***

[a] All density calculations assume use of conventional septic tank and drainfield wastewater treatment systems.
[b] DU = Dwelling Units; SF = Square Feet. For the purposes of this analysis, one dwelling unit is assumed to equal one SFE (Single Family Equivalent, as defined in Section 4.2).
[c] For explanation of terms in this category see Table 3.4-2.
[d] Basic assumptions regarding prototypical commercial developments are the same for these calculations as described under Table 4.3-3 for the No Action alternative.
[e] Derived from Big Sky Water and Sewer District SFE unit conversion table (WSD 2006a); an average of the SFE-to-SF conversions for retail uses (0.5 SFE per 1000 SF) and office uses (0.75 SFE per 1000 SF, is used for this land use classification, consistent with the use mix described above (i.e. SFE conversion of 0.68 per 1000 SF).
[f] Derived from Big Sky Water and Sewer District SFE unit conversion table (WSD 2006a); an average of the SFE-to-SF conversions for retail uses (0.5 SFE per 1000 SF) and light industrial uses (0.15 SFE per 1000 SF) is used for this land use classification (i.e., SFE conversion of 0.33 per 1000 SF).

[g] Derived from Big Sky Water and Sewer District SFE unit conversion table (WSD 2006a); the retail use conversion (0.5 SFE per 1000 SF) is used for this land use classification.
[h] Derived from Big Sky Water and Sewer District SFE unit conversion table (WSD 2006a); the "churches, conference/banquet/meeting room and similar facilities, with food service" conversion (0.5 SFE per 1000 SF) is used for this land use classification.

As shown on Table 4.4-5, a total of only approximately 75 dwelling units would be allowed in the build-out increment of the footprint when using conventional septic tank and drainfield wastewater treatment systems. Thirty-seven of these could be built on the developed and partially developed acreage in the Gallatin Canyon/Big Sky Zoning District, with 20 in the South Gallatin Zoning District and 18 in the Spanish Creek-Karst area. When compared with the No Action Alternative, these findings represent an overall 89% reduction in allowable dwelling units within the footprint. By area, the reduction would be 93% in the Gallatin Canyon/Big Sky Zoning District, 64% in the South Gallatin Zoning District, and 78% in the Spanish Creek-Karst area. Differences in the percentage reduction by area under the Proposed Action Alternative are a result of:

1. In the South Gallatin Zoning District, acreage of undeveloped land in the Recreation and Forestry zoning classification could support more dwelling units based on ORW phosphorus loading calculations than would actually be allowed by zoning. This higher number is used in describing the Proposed Action Alternative because of the uncertainty regarding allowable intensities of other uses that could be permitted in this zoning classification (e.g., guest ranches). It is reasonable to expect that these other uses could involve higher wastewater treatment loads than residential uses. Thus, the actual development limit imposed by the Proposed Action Alternative is most appropriate in this analysis.

2. In the Spanish Creek-Karst area, the number of dwelling units shown for the conservation easements is held constant (See Section 4.4.2).

On the commercial and community facilities acreage in the Gallatin Canyon/Big Sky Zoning District, approximately 2,645 square feet of facilities could be built under the Proposed Action, representing less than 1% of the estimated square footage allowed by existing zoning under the No Action Alternative. The assumptions described above for the No Action Alternative related to potential commercial or community use in the South Gallatin Zoning District and the Spanish Creek-Karst area (i.e., that all commercial facilities use a septic system) also apply to the Proposed Action Alternative.

Recreation

The Proposed Action would have no primary impacts on recreational use of the Gallatin River in the ORW study area. Perspectives on potential future expansion of developed recreation sites are discussed under Land Use, above. Aside from these possible expansions, no changes would occur in river access or the capacity of the river to accommodate recreational uses.

4.4.3.2 Secondary Impacts

The Proposed Action would have no adverse secondary impacts on land use or recreation in the ORW study area. The reductions in pollutant loads in the river that would accompany the Proposed Action, when compared with the No Action Alternative, may have a long-term positive effect on recreation by helping to protect the attributes of the river most important to recreation users. Hence, the quality of the recreational experience, in terms of aspects influenced by water quality, will be protected.

4.4.3.3 Cumulative Impacts

The Proposed Action would have no cumulative impacts on land use or recreation in the ORW study area.

4.4.3.4 Mitigation

Land Use

Mitigation of the primary land use impacts described above would take the form of alternative approaches to wastewater management/treatment. When compared with the conventional septic tank and drainfield wastewater systems assumed in the above analysis of Proposed Action land use impacts, alternative technologies can reduce pollutant discharge to the hydrologic system and ultimately to the river, and thus could ease or eliminate the constraints on land development densities resulting from the ORW's pollutant limits.

As discussed in Section 4.3.2 (See Table 4.3-1), alternative wastewater management technologies assessed for this EIS include:

- Advanced subsurface options
    - Recirculating sand filter
    - Chemical removal
    - Composting or incinerator toilet
- Zero-discharge options (off-site disposal)
    - Centralized treatment options
    - Non-discharge
    - Controlled hydrograph release

Tables 4.4-6 and 4.4-7 illustrate the comparative levels of allowable development with on-site wastewater treatment systems using these mitigation options, compared to the most conservative, "no mitigation" condition under the Proposed Action Alternative.

Table 4.4-6. Allowable residential development (all numbers are DU) within the footprint, using alternative wastewater treatment systems: Proposed Action Alternative, with and without mitigation.

Land Use Classification	No mitigation	Advanced on-site treatment mitigation options			Zero-discharge & centralized treatment mitigation options
		Re-circulating sand filter	Chemical removal	Composting/ incinerator toilet	
Gallatin Canyon/Big Sky Zoning District					
Residential					
Single Family 7500	1	1	2	3	226
Single Family 11000	1	1	2	3	67
Residential Cluster 1	2	3	4	5	60
Residential Cluster 2.5	7	10	14	19	72
Residential Cluster 5	12	17	24	32	66
Residential Cluster 10	7	10	14	19	15
Residential Cluster 20	7	10	14	19	10
Subtotal	***37***	***52***	***74***	***100***	***516***
South Gallatin Zoning District					
Canyon Residential	5	7	10	14	48
Recreation and Forestry	15	21	30	40	8
Subtotal	***20***	***28***	***40***	***54***	***56***
Spanish Creek-Karst Area					
Rural Areas	8	11	15	21	70
Conservation Easements	10	14	20	27	10
Subtotal	***18***	***25***	***35***	***48***	***80***
Total DU	***75***	***105***	***149***	***202***	***652***

Table 4.4-7. Allowable commercial development (all numbers are SF) in the footprint using alternative wastewater treatment systems: Proposed Action Alternative, with and without mitigation.

Land Use Classification	No mitigation	Advanced on-site treatment mitigation options			Zero-discharge & centralized treatment mitigation options
		Re-circulating sand filter	Chemical removal	Composting/ incinerator toilet	
Gallatin Canyon/Big Sky Zoning District					
Community Commercial	374	534	748	1,011	91,000
Commercial & Industrial Mixed Use	1,980	2,829	3,960	5,351	270,000
Recreational Business	218	311	436	589	45,000
Community Facilities	73	104	146	197	13,000
Total	***2,645***	***3,778***	***5,290***	***7,148***	***419,000***

As shown on Table 4.4-6, the advanced on-site wastewater treatment mitigation options would only mitigate potential ORW limitations to a small degree. The re-circulating sand filter option would still result in an 84% reduction in allowable dwelling units in the footprint (vs. 89%, unmitigated). The use of chemical removal and composting or incinerator toilet options would result in reductions in the number of allowable dwelling units of 77% and 69%, respectively. In terms of commercial or community development, none of these options would result in substantial easing of potential ORW restrictions. Compared to a 99.4% reduction in allowable square footage (Table 4.4-7) without mitigation, the re-circulating sand filter, chemical removal and composting/incinerator toilet options would still result in reductions of 99.1%, 98.7%, and 98.3%, respectively, in allowable commercial and community development square footage.

In contrast to these results for the advanced on-site options, the zero discharge and both centralized treatment options would fully eliminate adverse impact on development potential in the footprint. The full extent and intensity of potential development allowed under existing Gallatin County Plans and Zoning Districts could occur without constraint from limitations imposed by the proposed ORW designation.

Given the above analysis, it is clear that technical options exist for fully mitigating the potential adverse impact to land use (development potential) represented by the Proposed Action. The decision of involved landowners to use one or a combination of these options would likely be based on economic feasibility (see Section 4.5, Socioeconomics).

Recreation

Since the Proposed Action would have no adverse impacts on recreation, no mitigation is necessary.

4.4.4 Cumulative Impacts Analysis Alternative

4.4.4.1 Primary Impacts

Land Use

The Cumulative Impacts Analysis Alternative, without mitigation, would have primary impacts on future land use within the footprint. The impacts would be similar in magnitude to those under the Proposed Action, but would be experienced differently by landowners and developers, than under the Proposed Action, as described below.

<u>Magnitude of Impact</u>

The Cumulative Impacts Analysis Alternative, like the Proposed Action Alternative, would focus on placing an effective ceiling on total, future, and cumulative additions to the phosphorus and nitrogen loads reaching the river from wastewater treatment and disposal systems in the footprint. The “trigger values” defining this nondegradation ceiling would be the same for both the Cumulative Impacts Analysis and the No Action alternatives. Thus, the “baseline limits” on allowable development within the footprint (i.e., using conventional septic tank/leach field systems) for the Cumulative Impacts Analysis Alternative would be the same as those described

for the Proposed Action (i.e. approximately 75 additional dwelling units and 2,645 square feet of commercial/community facilities, as shown in Table 4.4-5).

However, unlike the Proposed Action Alternative, the Cumulative Impacts Alternative would retain two options under existing regulations for landowners and developers whose projects would cause exceedance of the pollutant trigger values and thus fail a nondegradation review. These options are: A) request review under DEQs narrative standard; and B) application for approval to degrade (see Section 2.2.1 for explanations of both options). By pursuing these options, landowners could potentially gain approval for developments using conventional septic tank/leach field systems that would exceed the approximately 75 DU or 2,645 SF baseline limits. It is not possible to quantify the extent to which these options would result in additional development beyond the baseline limits because for the narrative standard, conditions and results vary widely on a site-by-site basis, and for applications to degrade the criteria used are at least partially qualitative and subjective rather than strictly quantitative. Given the intent of Montana's water quality regulations and Nondegradation Policy, it is likely that total future development within the footprint would be limited (unless alternative wastewater systems are used—See Mitigation, below) to intensities much closer to those defined for the Proposed Action than those expected under the No Action Alternative.

<u>Distribution of Impact</u>

The Cumulative Impacts Analysis Alternative is essentially a "first come, first served" approach. From the date of formal adoption of the new cumulative analysis policy for the lands within the footprint, DEQ would begin a cumulative accounting of how much new developments contribute towards the pollutant trigger value, adding the loads of the most recent to all that have preceded it within the footprint. (Currently, phosphorus is the trigger value that would first be exceeded, and thus could limit development). No "per acre" allocation of the available additional (trigger value) pollutant load would be assigned to undeveloped or partially developed lands, and no "off the top" allocations (as described in Section 4.4.3.1) would be made for either the 10 dwelling units in the northerly conservation easement lands or for any possible future expansion of the State's Porcupine Creek complex. As long as the total development proposed from the date of policy change did not exceed the trigger value for phosphorus, individual applications would pass nondegradation review and be approved (i.e. no significant degradation). However, eventually a proposed development, adding a phosphorus load on top of all developments that preceded it, would cause an exceedance of the annual trigger value. That development application would be the first to fail nondegradation review and would be: 1) forced to seek approval through the narrative standard or application to degrade options; 2) required to use more expensive wastewater management systems (see Mitigation, below); or 3) relocate the disposal area. All subsequent applications for development would face the same requirements.

The basic result of this approach would be that landowners and developers (whether private owners or public agencies) who are ready to act quickly, submitting applications before the cumulative pollutant trigger values are exceeded, would be rewarded by gaining approval with little or no difficulty. Conversely, those who are not able or do not wish to act early, and thus begin the development permitting process once the trigger values have been reached or exceeded, would face substantially increased cost and/or difficulty.

Given these conditions, it is likely that the Cumulative Impacts Analysis Alternative would result in a brief spike in development activity within the footprint, as landowners and developers attempt to “get in under the wire.” It is not possible to predict where within the footprint this spike would occur or what type of development would be involved. However, it is likely that all (or the vast majority) of the development would be on privately owned lands (per existing Gallatin County Plans and Zoning) since the Forest Service has no plans for new facilities or expansion of existing facilities in the footprint (see Section 4.4.3.1), and since Montana Fish, Wildlife and Parks’ has no current plan to expand its Porcupine Creek complex (although may choose to do so in the future) (see Section 3.4.3.2).

Recreation

As with both the No Action and Proposed Action alternatives, the Cumulative Impacts Analysis Alternative would have no primary impacts on recreational use of the Gallatin River in the ORW study area. No changes would occur in river access or the capacity of the river to accommodate recreational uses.

4.4.4.2 Secondary Impacts

The Cumulative Impacts Analysis Alternative would have no adverse secondary impacts on land use or recreation in the ORW study area. Similar to the Proposed Action, reductions in pollutant loads in the river that would accompany the Cumulative Impacts Analysis Alternative when compared with the No Action Alternative (i.e., due to reduced intensity of allowable development overall), may have a long-term positive effect on recreation by helping to protect the attributes of the river most important to recreation users. Hence, the quality of the recreational experience, in terms of aspects influenced by water quality, will be protected.

4.4.4.3 Cumulative Impacts

The Cumulative Impacts Analysis Alternative would have no cumulative impacts on land use or recreation in the ORW study area.

4.4.4.4 Mitigation

Land Use

Mitigation of the magnitude of primary land use impacts described above would be essentially the same as that described for the Proposed Action (see Section 4.4.3.4). Mitigation of potential restrictions on development densities/intensities would take the form of alternative approaches to wastewater management and treatment. Advanced on-site wastewater treatment mitigation options would only mitigate potential limitations to a small degree, while zero discharge and centralized treatment options would fully eliminate adverse impact on development potential in the footprint. The decision of affected landowners to use one or a combination of these options would likely be based on economic feasibility (see Section 4.5, Socioeconomics).

No mitigation is possible for the distribution of impact under the Cumulative Impacts Analysis Alternative. A first come, first served approach is inherent in this alternative, rewarding landowners and developers who act quickly with relative ease and low cost in water quality

permitting. Those applying after the cumulative pollutant trigger values had been reached must contend with either potentially significant development restrictions (unless mitigation is used) or increased permitting and mitigation costs.

Recreation

Since the Cumulative Impacts Analysis Alternative would have no adverse impacts on recreation, no mitigation is necessary.

4.5 Socioeconomics

4.5.1 No Action Alternative

4.5.1.1 Primary Impacts

This section discusses the primary socio-economic impacts from the No Action Alternative. Under the No Action Alternative, changing water quality and altered recreational fisheries would primarily affect the economic value of fishing and would affect residential housing in the study area. Secondary impacts would include effects on tourism.

In order to assess the primary impacts of the No Action Alternative, it is necessary to link changes in water quality to human uses that have economic value. Based on the data and discussion in previous sections of this Chapter, including Land Use (Section 4.4) and Hydrology (Section 4.2), the No Action Alternative would allow a decline in water quality in the Gallatin River in the study area. This decline would only be allowed down to water quality standards, and not below that point. (The Gallatin River is currently of better quality than the standards.) This decline in water quality would result in an increase in algae, which would result in adverse aesthetic effects and adverse effects on oxygen in the river. According to the section on aquatic life (Section 4.6), these changes in water quality would shift the composition of macroinvertebrate species toward species with potentially less energetic value to trout. In the Fisheries Section (Section 4.7), the direct effect of increased nitrogen levels on trout fry (young trout) and the shift in composition of the trout food base has the potential to reduce trout numbers or trout size in the Gallatin River.

The reduction in trout population under the No Action Alternative would reduce trout catch rates and decrease angler satisfaction. While the magnitude of this reduction in trout population is not estimated in Section 4.7 (Fisheries), available evidence from Montana recreational stream fishing studies (Duffield et al. 1987, Duffield and Allen 1988) empirically demonstrates there would be a reduction in the number of angler trips with reduced catch rates. The results from that study indicate that there would be a less-than-proportionate reduction in angler use in response to any reduction in fish catch. This lack of proportionate response would help to moderate the loss in angler days associated with reductions in trout populations. Also partially moderating the loss in angler days is the fact that build-out of the area under the No Action Alternative would increase the number of study area residents and overnight visitors. An increase in the number of study area residents and visitors would only partially offset the reduction in trips by existing anglers because only between 5% (Ripple Marketing 1999) and 16% (May et al. 1997) of Gallatin River users were from the Big Sky and Gallatin Canyon area.

Lower catch rates and the resulting reduction in angler satisfaction from smaller trout or fewer trout caught would manifest itself in a reduction in the net economic value of fishing in this stretch of the Gallatin River (Duffield and Allen 1988). Even if new anglers came in to offset the loss of some of the existing anglers, there would still be fewer and/or smaller fish and, thus, lower net economic value of fishing to anglers than is currently enjoyed. At this time, the net adverse effect of the No Action Alternative on the current 31,500 angler days and current $3.8 million in net economic value is not known.

As discussed in Section 4.4.2, other river-related recreation such as kayaking, commercial rafting, and shoreline use is not expected to be adversely affected by the changes in water quality associated with the No Action Alternative. The build-out under the No Action Alternative would increase the number of residents and overnight visitors in the area. This would only slightly increase the number of rafting and non-angler use days as between 5% (Ripple Marketing 1999) and 16% (May et al. 1997) of Gallatin River users were from the Big Sky and Gallatin Canyon area. Thus, the approximately 20,000 commercial rafting days and more than 4,000 private shoreline and river boating use-days are expected to continue into the future and may increase slightly with the No Action Alternative. Thus, the nearly $6 million in current net economic value to boaters in the study area reported in Chapter 3 would be expected to continue or increase slightly if the No Action Alternative were implemented.

Property Values

The reduction in water quality and aesthetics associated with algae will result in either a slight reduction in property values or a slow down in the current rise in property values adjacent to or nearby the study stretch of the Gallatin River. Property value studies in other states reviewed in Chapter 3 indicated that water quality has an average effect of about 6% on a house price. Given this percentage and the relatively small reduction in water quality with the No Action Alternative as compared to the Proposed Action, property values are likely to decrease no more than a few percentage points due to water quality degradation from what they would be with current water quality (less than the 6% average). A relatively larger effect on reducing or slowing the rise in property values in the study area would result with the additional supply of dwelling units associated with unconstrained build-out under the No Action Alternative.

4.5.1.2 Secondary Impacts

Secondary economic impacts from the No Action Alternative include effects on the local economies of Big Sky, West Yellowstone, and to a lesser extent, Gallatin County. The secondary impacts of the decrease in water quality associated with the No Action Alternative could involve potentially adverse effects to existing angler use and spending, but this may be offset by positive effects associated with build-out of residential and vacation units.

As noted above in the section on primary impacts, the exact magnitude of the loss in trout population or trout size associated with the No Action Alternative is not known. As such, the net effect on angler use (reduction of existing anglers, but gain in new anglers associated with build-out) and angler spending and associated reduction in tourism income and employment are not known.

Since there is not expected to be any reduction in commercial rafting or other non-fishing river recreation tourism, current trends of increased economic activity associated with these types of recreation are expected to continue. Thus, employment associated with current commercial rafting companies would be expected to continue and might increase slightly due to the No Action Alternative.

The No Action Alternative allows for continued build-out of housing units following the existing zoning in the study area. As described in more detail in Section 4.4 on Land Use, build-out

within the footprint with current zoning is estimated to result in about 652 more dwelling units and 419,000 square feet of commercial space. This level of economic activity in the West Yellowstone Census County Division (CCD) and Big Sky Census County Place (CDP) will help to maintain current levels of direct employment in the construction (estimated at 274 combined jobs in Big Sky and West Yellowstone) and real estate sectors (currently about 140 jobs) of these two economies. The associated increase in population of residents and rental visitors will likely result in a small increase in income and employment in the retail and food services sectors once build-out is complete (much of current employment in these sectors relies upon visitors passing through the area as much as area residents). The addition of 652 more housing units should moderate the rise in house/condo price increases, and thus moderate the degree of unaffordability of housing compared to the household median income in the West Yellowstone CCD and Big Sky CDP areas. Essentially, increasing the supply of dwelling units, for a given amount of demand, should moderate housing prices. Existing upper income residents may form the “move up” market for the more expensive homes. This move up would open up these less expensive housing units for those in the market for more affordable housing. The extent of this moderation in the rise in house and condo prices would depend on the rate of increase in demand for housing in the study area, which is a function of the performance of the overall national economy and interest rates. However, the general upward trend in housing prices in Big Sky will likely continue regardless of the build-out under the No Action Alternative.

Allowing water quality to degrade would result in a loss in passive use values (option, existence and bequest; for explanation, see Section 3.5.3.8 of Chapter 3) to Montana residents from deterioration of water quality. This loss in passive use values would be a slight loss per household, due to relatively small reduction in water quality allowed under the current laws and the large number of other rivers available to Montana households.

4.5.1.3 Cumulative Impacts

Overall, the No Action Alternative, by allowing build-out of an additional 652 dwelling units, would help to maintain current direct employment in the construction and real estate sectors and should slightly increase employment in the retail and food services sectors. Build-out would help make housing in the study area more affordable. No decrease, and perhaps a slight increase in employment related to commercial rafting, would be expected if new study area residents and overnight visitors go commercial rafting. There could be a small loss in employment related to a reduction in existing nonresident fishing tourism associated with water quality-induced decreases in trout populations and angler catch rates, unless new residents and overnight visitors associated with build-out offset this.

Overall, the No Action Alternative would essentially maintain the current local economies of the Big Sky CDP and West Yellowstone CCD. The main economic losses would be the likely small reduction in net economic value of fishing to anglers from reduced trout catch or trout size in the Gallatin River and a small loss in passive use values of Montana residents associated with the decline in water quality in the river.

4.5.1.4 Mitigation

The majority of economic effects to the Big Sky CDP and West Yellowstone CCD economies would be positive, and therefore no mitigation of these effects would be required.

4.5.2 Proposed Action Alternative

4.5.2.1 Primary Impacts

Given that ORW designation, the Proposed Action, would protect current levels of water quality, the Proposed Action Alternative would maintain the current quantity and quality of recreation uses along the Gallatin River. Specifically, the current annual net economic value of fishing and other river-related recreation on the Gallatin River would be maintained by ORW designation protecting water quality. Total annual fishing days, (approximately 31,500), and an estimated $3.8 million in current annual net economic fishing value for the proposed ORW reach of Gallatin River for fishing would be maintained by ORW designation. It is also possible that ORW designation could be interpreted as a sign of quality for the Gallatin River and attract additional anglers, further increasing the economic value of fishing above the current level. Such increases in visitation have been observed with changing designation from a national monument to a national park.

An estimated $1,094,000 in net economic value for other non-angling, noncommercial recreation days on the river would continue with ORW designation. This is estimated as an annual value for boaters and other non-angling recreationists within the proposed ORW reach of the Gallatin River above what they actually pay for the trip.

With ORW designation, the net economic value of rafting to the commercial visitors themselves would continue to be $230 per day. Multiplying this amount by the estimated 20,000 commercial rafting days per year yields a net economic value of $4.6 million annually associated with maintaining water quality with ORW designation.

It is important to note that these net economic values are <u>not</u> the total benefits associated with the ORW. Rather, they are the values that would be maintained with ORW designation. To the extent that the No Action Alternative would lower these values, that amount of ‘lowering’ would be the economic water quality-related benefits of the Proposed Action. As mentioned above, the amount of lowered value under the No Action Alternative is unknown.

Property Values

The ORW designation would protect the existing property value differential associated with water quality. As discussed in Chapter 3, the available literature from areas outside of Montana suggests this increment to property value averages about 6% of property prices. Further, any limitations on build-out would limit the increase in supply of new dwelling units, and with a given level of demand, increase prices for existing and new units above what they would otherwise be under the No Action Alternative.

4.5.2.2 Secondary Impacts

Maintaining existing fishing, whitewater boating, and other river-related recreational use levels would maintain the current tourism economy on the Gallatin River at its existing levels. Thus, existing non-resident visitor expenditures would continue to flow into the area at current levels. Specifically, total nonresidents river recreation use (anglers, rafters, shoreline users) in 2003 is estimated to have been 25,491, leading to a total influx of out-of-state expenditures into Montana

of roughly $7.3 million (when calculated using 2005 dollars) that would continue to come into the state due to maintaining water quality in the Gallatin River. This monetary inflow would continue to provide the estimated 438 jobs associated with river recreation on the proposed ORW reach of the Gallatin River. Thus, existing angler and other river recreation use levels, and existing river tourism jobs and income would be maintained in Gallatin County, West Yellowstone CCD, and Big Sky CDP.

If future development within the footprint uses conventional subsurface wastewater treatment systems such as current septic systems, the Land Use Section (4.4.2) indicates that only about 75 additional dwelling units of build-out and 2,645 square feet of commercial facilities could be accommodated in the Big Sky and Gallatin Canyon Zoning District under the Proposed Action Alternative. Under the No Action Alternative, allowable build-out would be 652 units and 419,000 square feet of commercial space. Thus, the ORW Proposed Action, assuming that future homes/buildings use the standard septic systems currently found in the area, would result in a reduction in future development in the footprint area of 89% in allowed dwelling units and a reduction of more than 99% in commercial space of the two zoning districts. This substantial reduction in build-out within the footprint compared to the No Action Alternative would be due to nutrient production associated with standard subsurface wastewater treatment systems and overall nutrient limitations to maintain current water quality as required with ORW designation.

The reduction in supply of dwelling units and commercial space in the hydrologic footprint area as a result of ORW designation would likely increase the development rate on lands outside of the footprint in the short run. The extent of short-run substitution of development between areas is not known at this time, however, it would probably be less than a one-for-one substitution due to advantages of location for land within the footprint. In the long-term, the ORW designation with standard septic systems would result in a net reduction in development in the area since the lands outside of the footprint would probably have been developed at some future date. This reduction in the housing supply could accelerate the increase in prices of homes in the Big Sky area.

If standard subsurface wastewater treatment systems were to continue to be used in new residential and commercial construction in the footprint area, the reduced build-out with the Proposed Action Alternative would eventually reduce employment among the current 274 workers directly employed in the construction sectors of the Big Sky CDP and West Yellowstone CCD local economies. If half of the approximately 75 dwelling units allowed under the Proposed Action were single family homes and half were multi-family units (e.g., condos), then employment in new residential construction in these two economies could be reduced to an estimated 184 workers over time (a loss of 90 jobs) based on the number of jobs per unit in Gallatin County obtained from Adair and Heath (2002). However, there would continue to be other new residential and commercial construction jobs outside of the hydrologic footprint, as well as maintenance and remodeling jobs within and outside of the hydrologic footprint that would support construction jobs as well. Depending on the substitution of accelerated new construction outside of the footprint, and the increased demand for remodeling of existing homes within the footprint, much less than 90 jobs would likely be lost in the near term. If standard subsurface wastewater treatment systems were relied upon in the footprint area, long-term construction jobs may eventually fall by up to 90 jobs as the areas outside of the footprint would

have eventually been built out. It should be noted that once build out of the two zoning districts would occur (with or without ORW), construction jobs would eventually be reduced to just maintenance and remodeling levels. However, the eventual reduction of up to 90 construction jobs if standard septic is used, would eventually translate into as much as $6.86 million annually of reduced wages and salaries using data for Gallatin County in (Adair and Heath, 2002). Through multiplier effects, this reduction in employment and income would ripple through other related sectors of these two economies, such as real estate, transportation and local government revenue derived from real estate property taxes. Based on Adair and Heath (2002) these ripple effects would represent a reduction in these sectors of about 30 jobs but only about $550,000 in income due to the nature of these jobs.

As noted in the Mitigation section below, if builders switch to more advanced subsurface wastewater treatment systems within the footprint area, systems that reduce or even eliminate nitrogen and phosphorus discharge to the river, then much (or all) of the build-out associated with the No Action Alternative could still be accommodated with the Proposed Action Alternative (see Section 4.5.2.4). While these systems could do better than existing systems, it is unknown whether they could reduce nitrogen and phosphorus to the point of allowing a full build-out in the footprint area.

To the extent that area build-out potential within the footprint is limited as a result of ORW designation, housing affordability in the footprint areas would worsen somewhat from current levels, as the supply of residential units would be more limited; however, some of this housing demand may be able to be met outside of the footprint area. It is important to note that much of the remaining development potential in the Big Sky area is outside of the footprint and would not be subject to the ORW designation. Thus, only future development in the footprint would be limited by the ORW designation.

Passive use values (option, existence, and bequest values from water quality) to Montana residents associated with the current water quality would be maintained by the Proposed Action Alternative.

4.5.2.3 Cumulative Impacts

Existing net economic values associated with fishing and rafting would continue under the Proposed Action Alternative, as would current tourism-related income and employment. The build-out limitations imposed by maintenance of existing water quality would eventually reduce direct employment in the construction sectors by up to 90 jobs (up to $6.86 million in annual lost wages), and multiplier effects would result in slight reductions in real estate, transportation and state/local government during that time period by up to an additional 30 jobs. Housing affordability could be further reduced if demand for housing in the area continues to increase and build-out is limited. ORW designation would maintain the existing passive use values of Montana residents with respect to water quality in the Gallatin River.

4.5.2.4 Mitigation

In order to allow for attainment of full development potential of undeveloped and partially developed land in the footprint, there are three major types of options for developers and builders that could minimize, avoid, or reduce the overall adverse impacts of the Proposed Action

Alternative: 1) Improved subsurface wastewater treatment systems (See Table 4.2-1); 2) Water quality trading; and 3) Centralized wastewater treatment system(s) located outside of the footprint. Each is discussed below.

Alternative Wastewater Treatment Systems

As noted in the Hydrology Section 4.2.2.4 on mitigation of the Proposed Action Alternative, the allowable development within the ORW affected area could be increased from that estimated in sections 4.2.2 and 4.4.2, by reducing phosphorus and nitrogen loads from new developments (relative to conventional septic tank and drainfield treatment systems). Alternative treatment methods could include:

- Advanced subsurface treatment options
  A. Recirculating sand filter
  B. Chemical removal
  C. Composting or incinerator toilets

- Zero discharge options (off-site disposal of septic tank wastes to a wastewater treatment facility outside of the study area)

- Centralized treatment options
  A. Non-discharge
  B. Controlled hydrograph release

The economic consequences of these alternatives are summarized in the following section building upon Section 4.2.2.4 Mitigation.

Incinerator toilets have the lowest initial cost per SFE to reduce nitrogen and phosphorus with an initial cost of $3,200, although the 30-year total cost with operation and maintenance is $40,000. Composting toilets have an initial cost between $3,200 and $12,800, and a 30-year total cost (purchase, operation and maintenance) of $13,000 to $22,000 per SFE. Both the incinerator toilets and composting toilets are the most effective at reducing phosphorus and nitrogen (see Table 4.3-1). The next most cost effective options are recirculating sand filters with initial cost of $16,000 to $22,000 and a 30-year total cost of $17,000 to $20,000 per SFE. Sand filters are only about half as effective for reducing phosphorus and, therefore, would only allow half as many dwelling units to be built as would composting or incinerator toilets. For large developments (15 or more units) such as apartments, condominiums, or townhomes, adding a sequencing batch reactor to a traditional septic system would add about $12,500 per unit (Detmer 2006).

The economic impact of these higher costs is calculated by comparing these higher initial costs to house prices in the area. As noted in Chapter 3, the median price of an existing home is nearly $250,000 in the Big Sky area (although prices have risen significantly above that in the last year). With an initial cost of $3,200 to $12,800 for two composting toilets (equal to one SFE), compliance costs of ORW could represent a range of increases in costs of 1% to 5% to a house price for houses being built in the footprint of the West Fork of the Gallatin River in the Big Sky area.

Given that ORW designation would only affect new construction, and given the recent increases in lot prices, a $3,200 to $12,800 SFE cost would represent 1% to 2% of the price of the least expensive 27 lots listed in Big Sky Properties for December 2005 to January 2006 (Big Sky Properties 2006). When a house is added to the cost of the lot, the $3,200 to $12,800 per SFE would represent far less than one percent of the sale price of the home and lot.

It is also worth recalling that more than half the housing in the Big Sky area is not a primary residence or owner-occupied housing unit, but rather a vacation rental or second home. The vacation rental segment of the market has the ability to spread the one-time extra cost of community sewer treatment or other more expensive options over numerous customers over time.

The adoption of these advanced subsurface wastewater treatment systems would increase the build-out potential within the footprint (although the number of dwelling units mitigated would depend on the types of systems used) and help maintain the current levels of employment in the construction and real estate sectors of Big Sky CDP and West Yellowstone CCD. Adoption of subsurface wastewater treatment systems would likely result in a slight increase in employment in the construction, property management, and waste management services associated with construction and maintenance of these more effective subsurface wastewater treatment systems. For example, sealed septic systems would need to be pumped every four years and the sewage disposed of outside the study area, creating additional jobs in this industry.

Another approach for estimating compliance costs for large residential or commercial developments is to look at the cost of combining sewage from a group of development lots into a single community sewer system. The minimum cost for this per unit can be approximated using the sewage hook-up costs of Big Sky Water and Sewer District. Specifically, several developments outside of the current Big Sky Water and Sewer District boundary have requested to hook up their developments to Big Sky Water and Sewer District system. Given that the Big Sky County Water and Sewer District design capacity was based on its existing boundaries, and on the limited winter storage ponds and summer spraying areas for treated waste (e.g., golf courses), these requests were turned down (R. Edwards, pers. comm. 2006). As a result, these developments (e.g., Firelight Meadows) built their own community treatment systems. Given that these developments requested to hook up to Big Sky County Water and Sewer District, the Big Sky Water and Sewer District cost per housing unit is probably on par with the overall construction and time cost for a developer to construct such a system, otherwise the developer would not have requested the hook-up. Therefore, the cost of the Big Sky Water and Sewer District "Wastewater Plant Investment Charge," or what they call "PIC" [per Single Family Equivalent (SFE)], can be used as a rough estimate of the treatment costs of complying with the Proposed Action Alternative's nutrient discharge restrictions. These restrictions would affect parcels that are inside the footprint, and outside of an existing sewer system, and that do not have a current subdivision permit.

The PIC charged by Big Sky Water and Sewer District is $3,500 per SFE (www.bigskywatersewer.com). An SFE is based on a two bedroom-two bath residential unit. Each additional bedroom requires an additional 0.4 SFE. Thus, a three-bedroom condominium or house would require 1.4 SFEs, for a cost of $4,900. Studio apartments and hotel/lodge rooms are

0.7 and 0.75 SFEs, respectively. The Big Sky Water and Sewer District has set SFE values for commercial properties as well. (See www.bigskywatersewer.com website for the Single Family Equivalent Unit Conversion Schedule for a complete listing. (WSD 2006b)) In addition to these treatment costs with a centralized community system, the developer would also have to put in the infrastructure costs such as sewer pipes from each building to the centralized system.

Even if the cost of constructing small development systems is significantly higher than the cost of a PIC, it is still a small fraction of the estimated median price of a home in area. As noted above, the median price of an existing home was nearly $250,000 in the Big Sky area. Therefore, the $3,500 PIC is 1.4% of a house price in Big Sky. These increases in costs are also equal to or smaller than the value the house retains from maintaining high water quality. As noted in Section 3.5.3.8, regarding empirical estimates of the effects of water quality on property values, maintaining water clarity and absence of algae adds at least 3%, to as much as 20%, to house prices, with an average of about 6% (Boyle and Taylor 2001).

Given that Proposed Action Alternative would only affect new construction, and given the recent increases in lot prices, a $3,500 cost per SFE would represent less than one half of one percent of the least expensive 27 lots listed in Big Sky Properties for December 2005 to January 2006 (Big Sky Properties 2006). When a house is added to the cost of the lot, the $3,500 per SFE would most likely represent less than one-tenth of one percent of the sale price of the home and lot. A total cost of $10,000 to hook up to centralized treatment would still represent less than one percent of the sale price of a home.

With either the cost of advanced subsurface treatment options or the cost of a centralized treatment system, the initial cost to new construction on a single family home is likely to be less than 1%; however, the relative cost increases from either approach would represent a higher percentage on lower-priced multi-family dwelling units (as much as 5%).

Water Quality Trading

The second method for reducing the effect of ORW designation on the extent of build-out would be to have new developments within the footprint engage in water quality trading with existing units in the footprint that may not have hooked up to Big Sky Water and Sewer District, or that have old, poorly maintained septic systems contributing large amounts of phosphorus and nitrogen to the West fork of the Gallatin River. Water quality trading is allowed under EPA Region VIII guidance (EPA 1993) and might reduce the costs of compliance or the extent of reduction in build-out allowed in the footprint area. Trading would allow those wishing to add new sources of nitrogen and phosphorus within the footprint area to pay other point or nonpoint sources contributing these same pollutants into the same hydrologic area to reduce their discharges by the amount the new source would add, plus a safety margin (EPA 1993). For example, an existing residential unit in the footprint within, but not connected to, the Big Sky Water and Sewer District might be paid to connect to it. The SFE credit would be applied to a residential unit that is in the footprint and within the Big Sky area (but not on an undeveloped parcel of land that is eligible to be connected to the Big Sky Water and Sewer District). By agreeing to pay the $3,500 per SFE plus monthly fees, a new homeowner might be able to avoid more expensive treatment systems. Alternatively, a landowner wishing to develop along the Gallatin River corridor might be able to pay another landowner to control non-point source run-

off (e.g., from horse stables, etc.) and receive the credit to offset their nitrogen and phosphorus discharges and at a lower cost than installing the most expensive composting toilets at a initial cost of $12,800.

Whether the full extent of any dwelling unit cost increases can be fully passed as house price increases will depend on the relative price sensitivity of the housing demand relative to the housing supply. If there are substantial limitations to the No Action build-out, and increasing demand, nearly all of this cost increase will be passed on as higher dwelling unit prices.

Centralized Wastewater Treatment Systems Outside the Footprint Area

The third method for reducing the effect of ORW designation on the extent of build-out is the use of centralized wastewater treatment systems that are located outside of the vulnerability footprint area but that serve homes inside the footprint. This mitigation option would allow as many homes to be built within the footprint area, (652) as under the No Action Alternative, but may have many of the same water quality benefits as under the Proposed Action Alternative. However, centralized wastewater systems could result in higher development density in the footprint if zoning changes occur in the future as a result of the use of centralized systems.

4.5.3 Cumulative Impacts Analysis Alternative

4.5.3.1 Primary Impacts

The near-term primary impact of this alternative is to maintain the existing recreational fisheries (see Section 4.7.3.2) and, hence, the existing quality and $3.8 million economic value of recreational angling; (similar to impacts under the Proposed Action). The Cumulative Impact Analysis Alternative would also maintain the existing $6 million in rafting benefits, as would the No Action and the Proposed Action alternatives.

The near-term impact of this alternative on maintaining existing water quality and, hence, protecting the water quality premium of residential property values, is similar to the Proposed Action. Since the Cumulative Impact Analysis Alternative is administrative, rather than legislative in nature, its permanence and certainty is less than under the Proposed Action. Thus the full value of the current water quality premium may not be as fully capitalized into house prices as with the Proposed Action, but would still be higher than the No Action Alternative.

4.5.3.2 Secondary Impacts

In the near term, the Cumulative Impact Analysis Alternative would be similar to the Proposed Action in maintaining the existing 438 tourism-related jobs associated with fishing and rafting.

In the short term, the nature of the Cumulative Impact Analysis Alternative could stimulate an acceleration of development if builders race to develop the next roughly 67 SFEs within the footprint with conventional wastewater treatment systems. This brief acceleration of development might come about due to the perception that building the next 67 SFEs in the footprint will be easier or cheaper, since thereafter the phosphorus trigger value will have been reached, and the Cumulative Impacts Analysis Alternative would then allow limited or no development with on-site wastewater treatment systems. Thus, the Cumulative Impact Analysis

Alternative may initially stimulate the construction sector to increase construction employment above the current 274 jobs. Similar rapid development has occurred around Lake Tahoe, when the perception existed that increased regulation would soon make development more difficult (Sabatier and Pelkey, 1990). However, once the phosphorus trigger value is reached, construction of dwelling units could be reduced by 90% (as in the Proposed Action) and, correspondingly, construction jobs would fall by 90%. If DEQ were to accept requests for "narrative exceptions" for point source discharges contributing to phosphorus loading, or if landowners used alternative or non-discharging treatment options (discussed in the mitigation section), then development could continue. Therefore, in terms of construction jobs and related jobs, the impacts of the Cumulative Impact Analysis Alternative would be similar to impacts under the Proposed Action.

Like the Proposed Action, housing affordability would likely worsen due to the restriction on the number of dwelling units (with on-site wastewater treatment and disposal) that could be built within the footprint once the phosphorus trigger values have been reached, or due to the requirement for advanced wastewater treatment within the footprint. The extent of this effect on housing affordability depends on whether DEQ accepts requests for "narrative exemptions" to the water quality standards. If DEQ does accept such requests, then house price increases will be less than under the proposed action.

Similar to the Proposed Action, the Cumulative Impact Analysis Alternative would, in the near term, maintain the passive use values (option, existence and bequest values) associated with the current water quality. However, the reduced certainty of permanent water quality protection associated with the administrative nature of the Cumulative Impact Analysis Alternative (i.e., DEQ could choose to cease cumulative impact analysis at any time) as compared to the legislative protection of ORW status under the Proposed Action, may slightly reduce Montana residents passive use values under the Cumulative Impact Analysis Alternative.

4.5.3.3 Cumulative Impacts

In the near term the Cumulative Impact Analysis Alternative would have similar effects as the Proposed Action in terms of the economic value of recreational fishing and boating, as well as tourism-related employment and construction-related employment.

4.5.3.4 Mitigation

As with the Proposed Action, properties that would be denied permits to develop using conventional wastewater treatment would, under the Cumulative Impact Analysis Alternative, have the option to develop using more advanced wastewater treatment or centralized/community treatment systems. These systems and their costs are discussed in detail in the section on the Proposed Action. Thus the effects of the Cumulative Impact Analysis Alternative on house prices would be similar to the Proposed Action, increasing housing costs by between $3,200 and $20,000. This increase in costs represents between less than 1% of the cost of a single family home to 5% per dwelling unit for multi-family units. See the discussion of Mitigation in the Proposed Action for more details.

4.6 Aquatic Life and Habitats

The alternatives will allow for substantial development in the Gallatin Valley along the proposed ORW reach. The footprint is a valuable tool for impact analyses because it highlights the land area with the most potential to provide nutrient input to the Gallatin River.

4.6.1 No Action Alternative

The No Action Alternative would continue management of the proposed ORW reach under the current set of regulations and policies as described in Chapter 2. The Montana Water Quality Act (75-5-101, et seq., MCA) restricts degradation of high quality state waters, such as the Gallatin River, and provides a degree of protection to existing water quality in the river. The suite of regulations that apply to subsurface wastewater treatment facilities (e.g., septic systems) assess each potential application independently instead of cumulatively; in other words, the more sources of septic effluent, the greater will be nutrient loads to the river. As a consequence, it is likely that water quality will degrade over time as the level of development increases in the proposed ORW reach. Because the Proposed Action is a policy action, the impact of the No Action and Proposed Action alternatives will be gradual to aquatic life, and subject to human factors such as the rate of development within the footprint and the number and types of individual wastewater systems that contribute nutrients to the river. Therefore, the rate of degradation of water quality is difficult to quantify; however, the extent of degradation can be estimated based on the number of potential wastewater inputs to groundwater.

4.6.1.1 Primary Impacts

There would be little immediately measurable impact to biological aquatic resources as a result of the No Action Alternative. The gradual decline in water quality, documented in Section 4.3, may accelerate in concert with the increasing rate of development along the proposed ORW reach, particularly in the Big Sky area. The fact that these impacts may be delayed in time due to the hydrological and biological controls on nutrient distribution does not minimize their connection to the No Action Alternative. As with other natural resources, predominate impacts to aquatic habitat are secondary, caused by water quality degradation over time.

4.6.1.2 Secondary Impacts

Over time, the potential for secondary impacts to the aquatic ecosystem may be substantial. Secondary impacts to aquatic resources due to adoption of the No Action Alternative would include shifts in the periphyton and macroinvertebrate communities as nutrient levels increase (Allan 1995). Aquatic growth of the algae and rooted plants found in lakes, rivers, and streams requires certain nutrients. Nutrients required in the greatest amounts are nitrogen and phosphorus (GDR 1998, Allan 1995). Some input of these nutrients is needed to support normal growth of aquatic plants and algae, important parts of the aquatic food chain. Too much nutrient input can result in an overabundance of algal growth with a variety of undesirable impacts.

As described in Section 4.3.1, it is reasonable to assume for the No Action Alternative there would continue to be measurable increases in phosphorus in the Gallatin River. Nitrogen levels would also be likely to increase in concert with the growing number of septic systems within the footprint. The levels and rates of this steady nutrient increase can be inferred based on rates of

development along the proposed ORW reach, numbers of septic systems currently in use and approved for future use, and trends in nutrient impacts observed in previous biological assessments in the West Fork of the Gallatin River (Bollman 2005, Marcarelli 2005, Bahls 2004). The discussion below will focus on general trends that can be anticipated under any increase in nutrient loading. The severity of the response in the biological process in the ORW will reflect the level of nutrient input. Therefore, mitigation for all alternatives would focus on controlling and reducing nutrient inputs to the Gallatin River.

Impacts Due to Nutrient Input

Biological activity takes up and processes nutrients as part of the food web and related nutrient cycles. Nutrients are added to aquatic systems through dead and decaying materials, such as leaves and woody materials, and through dissolved materials, such as nutrients that are leached from soils. Human input of nutrients can also take several forms, such as direct discharge from storm water drains; surface runoff of fertilizer, livestock manure, or sediment; and percolation through soils and groundwater of materials from a wastewater treatment system, such as individual or community septics. The primary processors of dissolved nutrients are algae, aquatic plants, zooplankton, and detritivores (organisms that eat dead materials). Nutrients make their way up the food chain as other organisms eat these initial processors. When the nutrient supply exceeds demand, changes occur in the food web and the biological community.

The condition of excessive nutrient-induced algal and plant production is known as eutrophication, and waters affected by this condition are said to be eutrophic (Armantrout 1998). Waters such as the Gallatin River, with limited nutrient supplies and lower biological activity, are considered “oligotrophic.” An oligotrophic system has low levels of nutrients and is usually characterized by clear waters and limited algal growth. The Greek root “oligo” means “few” or “small” and the productivity of oligotrophic waters lies below that of mesotrophic (meso = “middle”) waters, which have moderate productivity and aquatic life, and eutrophic waters, which can sometimes have excessive algal growth problems associated with their heavy loads of nutrients. Eutrophic waters often experience dense blooms of algae, which can lead to unaesthetic scums and odors and interfere with recreation. In addition, overnight respiration of living algae, and decay of dead algae and other plant material, can deplete oxygen from the water, stressing or killing fish. Eutrophication of lakes and rivers typically results in a shift in macroinvertebrate and fish populations to less desirable, pollution-tolerant species (Allan 1995). Some waters in warmer regions are naturally eutrophic and their biological communities are adapted to higher nutrient levels. Eutrophication of naturally oligotrophic waters is problematic because the native community cannot take in the increased nutrients rapidly enough causing chemical and physical changes in the surrounding waters. Oligotrophic waters develop associated fish and aquatic communities; changing the nutrient content (eutrophication) changes the community as well. The Gallatin River aquatic ecosystem and its fishery are supported by an oligotrophic system; they cannot be expected to persist at the same level and with the same species as eutrophication progresses.

For freshwater aquatic systems, the nutrient in the shortest supply relative to algal and plant demands is usually phosphorus. Of the variety of ways that phosphates enter a water body (water treatment, agricultural application, residential application, storm runoff, snow melt, and biological processes), several are linked to human activities. In the periphyton assessment

completed in 2004, nitrogen appears to be “limiting” as phosphorus is usually readily available in the Gallatin River in and around Big Sky, possibly because of the concentrated development nearby (Bahls 2004). Therefore, in the proposed ORW reach, it is the nitrogen supply that currently limits plant growth (Bahls 2004). The bulk of the nitrogen in freshwater systems is found in one of three ionic forms—ammonium (NH_{4+}), nitrite (NO_{2-}), or nitrate (NO_{3-}). Nitrite and nitrate are more readily taken up by most algae; however, both nitrate and ammonia can be toxic to fish and other aquatic life.

The process by which ammonia becomes nitrate is part of the nitrogen cycle, a biochemical conversion process that is important to understand because it controls the forms of nitrogen released by septic systems that ultimately enter the Gallatin River. In general, feces contain nitrogen in proteins which are quickly broken down into ammonia by decomposers and bacteria (as in a septic system). When ammonia enters aquatic systems, bacteria use oxygen to convert it to nitrite. Nitrite is toxic to most life even in low concentrations, but some bacteria specialize in converting nitrite to nitrate, again using oxygen. Nitrate is the final stage in this conversion, which is one reason why nitrate concentrations are used as indicators for water quality.

As organic materials decompose via the nitrogen cycle, they place an oxygen demand on the receiving waters which may adversely affect fisheries and cause other problems with taste, odor, and color. The oxygen used up in the decomposition and nitrate conversion processes is not available to other aquatic life. Increased nitrate concentrations can also reduce the ability of aquatic animals to take up oxygen by converting blood pigments, such as hemoglobin, to forms with lower affinities for oxygen (Camargo et al. 2005). This double-edged effect of both decreased oxygen and less ability for organisms to take it up from excess nitrate diminishes oxygen availability, increases metabolic stress for organisms, and reduces the quality of aquatic habitat. These effects are what qualify excess nitrate as pollution in aquatic systems. Nitrate concentrations are often used as an indicator analyte (substance which a laboratory test aims to detect) for water quality, since waters contaminated by waste from humans and other mammals may also contain pathogens, including fecal bacteria, which are harmful to humans.

Most aquatic systems where eutrophication becomes problematic to the point of nuisance-level algal growth are warm or encompass slow-moving rivers or lakes where the nutrients are taken up by algae and zooplankton at high rates. The proposed ORW reach is a very cold, turbulent system. Biological activity in this reach is quite low as is nutrient uptake (Marcarelli 2005). Even in this thermally restricted system, recent monitoring has shown reductions in species diversity and proliferation of pollution-tolerant species in the lower reaches of the West Fork of the Gallatin River, downstream from the major residential developments in the Big Sky area (Bollman 2005, Bahls 2004). As an example, members of the pollution-tolerant Chironomidae (midges) have replaced less tolerant groups such as Ephemeroptera (mayflies) (Bollman 2005). The nutrients from the West Fork enter the Gallatin River just upstream of the areas where aquatic community shifts in the mainstem of the Gallatin River due to water quality changes have been documented. As nutrient levels increase beyond biological capacity, much of this nutrient supply may be “exported” from the proposed ORW reach downstream to the lower reaches of the Gallatin River where temperatures are warmer and nutrients can be more readily utilized by organisms (USGS 2006b).

Recent research on temperature effects on nutrient uptake by algae offers some context for this premise. Marcarelli (2005) researched nutrient uptake response to temperature in aquatic systems. In her nutrient controls (where the nutrient levels were held constant in each system), warm temperature (18°C [64.4ºF]) boosted nitrogen fixation (uptake) two times above cold temperature (13°C [55.4ºF]) (Marcarelli 2005). When phosphorus was added to the nutrient input, the same temperatures increased nitrogen fixation by 20 times (Marcarelli 2005). This study indicates that nitrogen fixation is stimulated both by temperature and phosphorus, but the magnitude of response to phosphorus was much greater than to temperature alone. In the Gallatin River, this result suggests that as the nutrient-rich water moves downstream, the availability of phosphorus, combined with warmer downstream temperatures, may lead to dramatic increases in nitrogen uptake and algal growth.

Water temperatures in the proposed ORW reach (measured near the confluence of Spanish Creek) rarely exceed 13ºC (55.4ºF), even in the summer months, but downstream near Logan summer temperatures can reach 15ºC (59ºF) by mid-May and generally exceed 18ºC (64.4ºF) by July (USGS 2006b) (Table 4.6-1). Thus, water temperatures in the summer near Logan are the same as those in the Marcarelli (2005) study discussed above, where temperatures interacted strongly with phosphorus to greatly increase nitrogen uptake and algal growth.

The period of record for the two USGS water monitoring stations on the Gallatin River extends from 1952 (one measurement at Logan) through 2004, and both stations were monitored regularly between 1982 and 2004 (USGS 2006b). Monitoring was much more frequent at the Gallatin Gateway station, with measurements taken once a month during most years (Figure 4.6-1). After 1989, both stations were monitored regularly during the summer months (Table 4.6-1). Monitoring at the Logan Station was generally limited to July and August, with a few measurements in May and June, although more than one measurement per month was taken in some years.

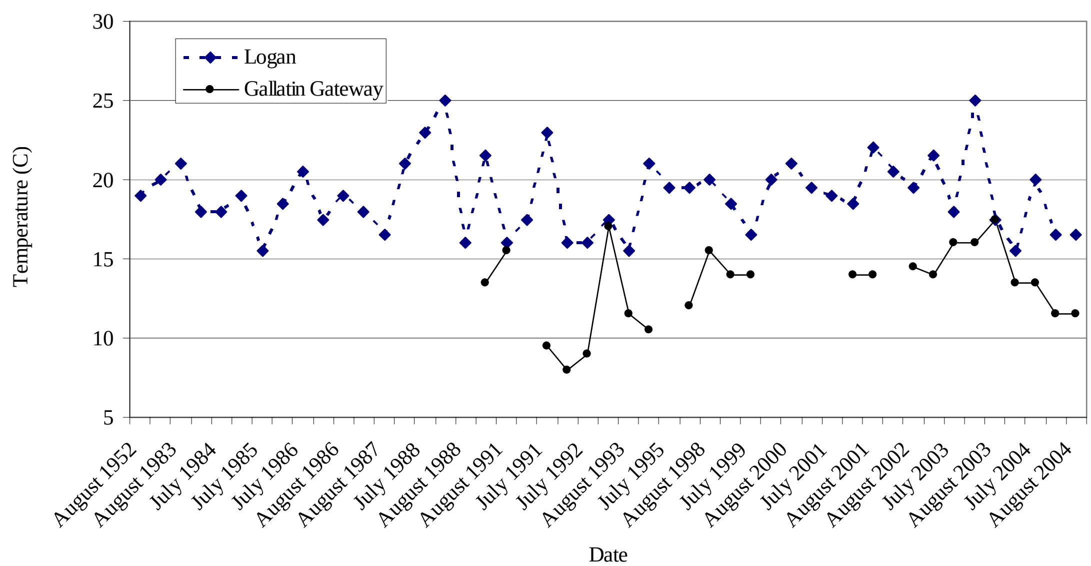

Figure 4.6-1. Water temperature readings taken at two USGS stations (Gallatin Gateway Station, USGS 06043500, and Logan Station, USGS 06052500) on the Gallatin River, Montana from 1952 to 2004.

Table 4.6-1. Summary of water temperature readings taken at two USGS stations on the Gallatin River, Montana during July and August from 1989 to 2004.

	Gallatin Gateway Station USGS 06052500	Logan Station USGS 06043500
Total number of measurements	23	30
Measurements exceeding:		
13º C	15	30
15ºC	6	30
18ºC	0	18
20ºC	0	8

Marcarelli’s (2005) results also showed a shift in the number and types of small photosynthetic organisms (diatoms) in the stream communities in response to the nutrient increase. This result supports the hypothesis that biological characteristics in streams, including community structure and biological processes, would be altered by increased nutrient input when coupled with a warming water temperature gradient.

Bollman’s (2005) review of the macroinvertebrate samples for the West Fork of the Gallatin River show a slight shift from 2001 to 2004 in the community towards more pollution-tolerant organisms, such as certain midges and other tolerant groups. DEQ uses three bioassessment indices to rank site impairment levels based on macroinvertebrate samples; each is calibrated for a general ecosystem type. The three indices used are the Plains, Valley and Foothills, and Mountain streams. These three indices allow comparisons among aquatic communities typical of each ecosystem so that a Mountain stream is not ranked based on criteria for a Plains stream and vice versa. Upper reaches and tributaries of the Gallatin River are typical Mountain streams, while reaches downstream of the West Fork confluence are intermediate between Mountain and Valley and Foothill streams. In 2005, the site at the West Fork of the Gallatin River and the site just downstream of the confluence of the West Fork with the mainstem are rated as “slightly impaired” using the Plains and Valleys and Foothills rating indices, and the site on the West Fork of the Gallatin River is rated as “severely impaired” using DEQ’s Mountain stream index (Bollman 2005). Diversity of macroinvertebrate species is still very high at all sites, but the shift to the pollution-tolerant midge family from 2001 to 2005 has potential impacts to upper levels in the food web, which are discussed in Section 4.6.2, below.

When a system becomes overloaded with nutrients, a shift in the macroinvertebrate community often occurs, and pollution-intolerant stoneflies, mayflies, and caddis flies are replaced by midges, aquatic worms, and black fly larvae (Barbour et al. 1993). Pollution-tolerant macroinvertebrate groups often complete more than one life cycle per year and may breathe air as larvae. These attributes reduce the effect of sporadic nutrient pulses and allow the organisms to avoid the impact of nitrate on oxygenation. These organisms are often small-bodied and, although they are commonly utilized as food resources for trout, represent lower energy value per individual ingested.

Under the No Action Alternative, it is likely that the macroinvertebrate community in the mainstem of the river would continue to shift towards a more nutrient-tolerant community,

similar to that identified in the West Fork of the Gallatin from 2001 to 2005. The shift is not dramatic, but macroinvertebrates used as indicators of low water quality appear to be replacing those indicative of higher water quality (Bollman 2005). As an example, midges (Chironomidae) constituted over 63 and 75% of the total macroinvertebrate samples taken in April 2003 and July 2004, respectively (Bollman 2005). Macroinvertebrate communities vary seasonally, but water quality degradation can be inferred when pollution-tolerant groups dominate the community. The results from the West Fork of the Gallatin River (Bollman 2005), a water body currently listed as impaired by nutrients, is a good indicator of the types of changes in the aquatic community that may be likely in the ORW under the No Action Alternative.

4.6.1.3 Cumulative Impacts

The cumulative impacts for the No Action Alternative would include shifts in the periphyton and macroinvertebrate communities as described under secondary impacts. Reasonably foreseeable actions that might intensify these impacts would include the potential for decreased surface water supply due to residential water use by those who occupy houses built inside the footprint. Since very little of the lands in the footprint are arable, little irrigation occurs currently or is likely in the future. Residential development would involve drilling individual or community groundwater wells that would probably intercept subsurface water flowing toward the proposed ORW reach. By diverting these waters to household taps before they reach the mainstem of the Gallatin, total flow of the Gallatin River may be reduced. Reduced flow would diminish the overall dilution of nutrients after they enter the Gallatin River. As with all of the impacts discussed, the extent of this effect is difficult to quantify because it is subject to several interacting human factors. The overall cumulative impacts to water quality would be commensurate with the intensity of future development under existing regulations and standards.

For the South and West forks of the Gallatin River, DEQ is developing TMDLs, which will include water quality restoration plans and prescriptions for reducing nonpoint pollution in these watersheds. These water bodies are listed as impaired for nutrients and suspended solids (DEQ 2005b. If nutrient targets for these water bodies are set to reduce overall nutrient concentrations, this development of nutrient targets would potentially decrease nutrient levels contributed to the proposed ORW reach. Participation and cooperation with TMDLs is voluntary for nonpoint sources such as septic systems; no fines or penalties are enforced for noncompliance with water quality restoration plans. Therefore, the efficacy of the TMDL program for reducing nonpoint source nutrient input is low in the absence of a change in regulation by DEQ.

4.6.1.4 Mitigation

The overarching impact from the No Action Alternative is the potential increase in nutrient inputs to the proposed ORW reach and the cascading chemical and biological effects in the aquatic ecosystem. Once the nutrients are introduced into the river, there is little that can be done to rectify the impacts; therefore, mitigation should focus on avoiding, minimizing, and reducing nutrient sources. Mitigation of impacts to aquatic resources from the No Action Alternative focuses on reducing nutrient inputs to the proposed ORW reach. Section 4.3.2 discusses several types of septic treatment systems capable of reducing nutrient output from individual and community septic systems. Adoption of these septic treatment systems could substantially reduce net nutrient input to the Gallatin River.

Effective mitigation actions would most likely be the result of changes to state regulations and local land use policies related to residential development within the footprint. Actions that would mitigate impacts to aquatic life and resources due to the No Action Alternative would include:

- Adoption of more stringent nutrient trigger values for effluent from development within the footprint
- Cumulative evaluation of septic approvals on an additive annual basis
- Increased minimum lot sizes for areas within the footprint area adjacent to the river
- Regulation of individual, subsurface wastewater systems as point sources to surface water when part of a subdivision development
- Enforcement of water use limits during the summer season to reduce groundwater use from wells
- Incentive programs for or regulations requiring more efficient nutrient removing septic alternatives for new-home installation or replacement of existing septic systems.

4.6.2 Proposed Action Alternative

The preservation of existing water quality of the proposed ORW reach would benefit aquatic life in that reach and in downstream reaches. Adoption of the Proposed Action Alternative would result in several positive impacts to aquatic life within the proposed ORW reach as well as downstream of Spanish Creek. The current macroinvertebrate community thrives in the cold, relatively clean waters of the Gallatin River. Fish and macroinvertebrates are the organisms that would directly benefit by the change in management of the proposed ORW reach. The river water is the defining element of their habitat, providing both oxygen and a consistent source of food.

4.6.2.1 Primary Impacts

As with the No Action Alternative, there would be little immediate, measurable impact to aquatic resources as a result of implementing the Proposed Action Alternative. The primary consequence would be a change from the recently documented trend of degrading water quality to a stabilized level of water quality. The effect of maintaining current water quality conditions would be illustrated by species diversity and, ultimately, preservation of the Gallatin River as suitable aquatic habitat for salmonids. The benefits of the Proposed Action Alternative, when viewed as an alternative to the slow, but marked, decline in water quality, are substantial.

4.6.2.2 Secondary Impacts

As with the No Action Alternative, stabilization of or even improvements to aquatic habitat, resulting from an ORW designation, represent positive secondary impacts to water quality. Under the Proposed Action Alternative, DEQ would manage the proposed ORW reach to preserve existing water quality. This means that new developments proposed within the footprint would need to meet the nutrient loading guidelines (See Section 4.3.2). Overall, the result of this new regulation would mean the existing nutrient load carried by the proposed ORW reach would not measurably increase over time as a result of wastewater discharges. Other factors and sources could lead to increased nutrient loads in the river. Current water quality in the proposed ORW reach is very good, with nutrient levels consistent with an oligotrophic system (Armantrout 1998, BWTF 2006). As mentioned in the discussion above, cold temperatures in the upper Gallatin

River contribute to low nutrient uptake and help maintain existing oligotrophic ecologic conditions. Macroinvertebrates that thrive in unpolluted, oligotrophic systems include several relatively large-bodied orders such as stoneflies, mayflies, and caddis flies (Barbour et al. 1993). These orders are also good sources of calories for trout. Species diversity in any ecosystem is usually an indicator of stability. In the case of the macroinvertebrate community in the Gallatin River, higher species diversity translates into a broader food base for trout, amphibians, and other organisms that forage along the water's edge for insects.

4.6.2.3 Cumulative Impacts

Cumulative impacts of the Proposed Action Alternative would include continued maintenance of the existing high quality aquatic habitat based on preservation of the current water quality. The ongoing TMDL programs may also reduce nutrient loading as mentioned in the No Action Alternative discussion of cumulative impacts. However, these reductions are not mandatory. The Proposed Action Alternative would most likely reduce the total build-out realized in the Big Sky area because of the more stringent nutrient loading criteria within the footprint. Reductions in total future numbers of septic systems and potentially total residential wells could help to maintain the existing groundwater supplies. If the mitigations described in Section 4.3 are implemented, then the full build-out potential could be realized without the negative impacts to water quality. Any action that helps to maintain overall water availability in the Gallatin watershed would benefit the health and vigor of the aquatic environment and the periphyton and macroinvertebrate communities.

The Proposed Action Alternative could also result in larger centralized community wastewater treatment systems outside the vulnerability footprint and higher density housing within the footprint area. Higher density development could increase discharges from other sources of nutrients, such as storm water runoff, to the Gallatin River.

4.6.2.4 Mitigation

There would be no negative impacts to aquatic resources or habitat due to adoption of the Proposed Action Alternative; therefore, no mitigation of impacts would be necessary.

4.6.3 Cumulative Impacts Analysis Alternative

The Cumulative Impacts Analysis Alternative is similar to the Proposed Action Alternative in that the DEQ would assess each new potential nutrient source in the context of current and past nutrient inputs to the proposed ORW reach. The assessment of new developments in the context of existing water quality in the proposed ORW reach may benefit the aquatic resources in that reach and in downstream reaches. Adoption of the Cumulative Impacts Analysis Alternative could result in positive impacts to the aquatic resources similar to those described for the Proposed Action Alternative within the proposed ORW reach as well as downstream of Spanish Creek.

The Cumulative Impacts Analysis Alternative is more protective of water quality and thus aquatic life than the No Action Alternative, but this protection is not guaranteed because this alternative represents a change in policy, not in law.

4.6.3.1 Primary Impacts

As with the previous two alternatives, there would be little immediate, measurable impact to aquatic resources as a result of implementing the Cumulative Impacts Analysis Alternative. The primary consequence would be a change from the recently documented trend of degrading water quality to a more closely evaluated and managed level of water quality, with the goal of staying below prescribed trigger values. The effect of cumulative impact assessment of water quality conditions would be to reduce overall impacts to water quality and conservation of the Gallatin River as suitable aquatic habitat for salmonids, although at a less stringent level than under the Proposed Action Alternative. The benefits and impacts of the Cumulative Impacts Analysis Alternative to aquatic resources are intermediate between the No Action and the Proposed Action alternatives.

4.6.3.2 Secondary Impacts

As with the Proposed Action Alternative, stabilization or conservation of aquatic habitat, resulting from the Cumulative Impacts Analysis Alternative, represents positive secondary impacts to water quality. Under the Cumulative Impacts Analysis Alternative, DEQ would evaluate each potential impact to water quality along the proposed ORW reach in the context of existing and past pollutant inputs, and compare these totals with trigger values. This means that the nutrient load of each subsequent new development proposed within the footprint would be added to the existing nutrient loading (See Sections 4.3.3 and 4.4.4). Other factors and sources not regulated by nondegradation review could lead to increased nutrient loads in the river.

The Cumulative Impacts Analysis Alternative potentially places an endpoint on total nutrient input to the proposed ORW reach. Secondary impacts from adopting this alternative may lead to some degradation in current water quality that may negatively impact aquatic resources, but it is unlikely that the water quality would be allowed to degrade beyond the trigger values which are still substantially lower than current water quality standards. As an example, the trigger value for nitrate is 0.01 mg/l, while the current water quality drinking standard is 10mg/l (DEQ 2006a). Species diversity is generally directly related to water quality, and higher diversity in any ecosystem is usually an indicator of stability. In the case of the macroinvertebrate community in the Gallatin River, higher species diversity translates into a broader, more reliable food base for trout, amphibians, and other organisms that forage along the water's edge for insects.

4.6.3.3 Cumulative Impacts

Cumulative impacts of the Cumulative Impacts Analysis Alternative would likely include maintenance of the existing high quality aquatic ecosystem based on limited and sporadic negative impacts to current water quality and the supporting aquatic habitat. As mentioned above under the Proposed Action Alternative, the ongoing TMDL programs may also reduce nutrient loading. However, these reductions are not mandatory. The Cumulative Impacts Analysis Alternative would most likely reduce the maximum development potential for the Big Sky area because of the potential incrementally more stringent nutrient loading criteria within the footprint.

Similar to the Proposed Action Alternative, the Cumulative Impacts Analysis Alternative could also result in larger community wastewater treatment systems outside the footprint and higher

density housing within the footprint area. Reductions in total future numbers of residential or community wells would help to maintain the existing groundwater level. Any action that helps to maintain overall water availability in the Gallatin watershed would benefit the health and vigor of the aquatic environment and the trout fishery.

The administrative nature of this alternative has been mentioned several times. If the policy required to implement the Cumulative Impacts Analysis Alternative is changed in the future, then conditions and potential impacts would revert back to those described for the No Action Alternative. Whether this reversion may occur, as well as what the water-quality conditions might be when it did occur, are impossible to predict. Therefore, it is very difficult to assess the potential for cumulative impacts to aquatic resources under this alternative.

4.6.3.4 Mitigation

Impacts to the Gallatin River resulting from the Cumulative Impacts Analysis Alternative would be similar to those described under the Proposed Action Alternative because there water quality management would become more stringent as the trigger values were approached. Once the trigger values are met, then there would be little if any further negative impacts to aquatic resources due to this alternative. Therefore, mitigation for the Cumulative Impacts Alternative would be similar to that described under the Proposed Action Alternative

4.7 Fisheries

4.7.1 No Action Alternative

Under the No Action Alternative, DEQ would continue to manage the proposed ORW reach under the current set of regulations and policies as described in Chapter 2. The Montana Water Quality Act (75-5-101, et seq., MCA) restricts degradation of high quality state waters and protects existing water quality in the Gallatin River. The regulations that apply to subsurface wastewater treatment facilities (e.g., septic systems) assess each potential application independently instead of cumulatively; therefore, it is likely that water quality will be degraded over time as the level of development increases in the proposed ORW reach. Because this action is a policy action, the impact of the No Action Alternative, and all other alternatives, would be gradual and subject to human factors such as the rate of development within the footprint and the number and types of individual wastewater systems that contribute nutrients to the river. The rate of degradation of water quality may be difficult to quantify; however, the extent of degradation can be estimated based on the number of potential wastewater inputs to groundwater.

4.7.1.1 Primary Impacts

There would be little immediate, measurable impact to fish as a direct result of the No Action Alternative. The gradual decline in water quality, documented in Section 4.3.1, may accelerate in concert with the increasing rate of development along the proposed ORW reach, particularly in the Big Sky area. The fact that these impacts may be delayed due to the hydrological and biological controls on nutrient distribution does not minimize their connection to the No Action Alternative. The amount of development is pertinent to the fishery because the nitrate loading from septic system drainage will be seasonal and is more consequential during low water flows. Also, nitrate loads increase with continued residential and commercial development. As with other natural resources, predominate impacts to fisheries are secondary, caused by water quality degradation over time.

4.7.1.2 Secondary Impacts

Nitrate levels can adversely affect fish by reducing oxygen uptake in the blood (Camargo et al. 2005). Nitrate is reduced to nitrite in a fish's body under conditions of low oxygen, forcing the replacement of hemoglobin, an oxygen-binding blood pigment, with pigments that do not carry oxygen. This conversion results in less efficient metabolism and increased stresses on physiological processes. Camargo et al. (2005) recommend maintaining nitrate levels below 2.0 mg/L for sensitive aquatic organisms such as rainbow trout fry. They found that rainbow trout fry exposed to nitrate levels as low as 2.3 mg/L for 30 days demonstrated adverse effects due to oxygen deficits (Camargo et al. 2005, Kincheloe et al. 1979). Tables 4.7-1 and 4.7-2 provide nitrate and phosphorus toxicity information for several aquatic species to demonstrate the relative tolerances of different organisms. It should be noted that toxicity studies focus on concentrations and exposures that are lethal to a given test population, but chronic exposures to lower levels have been shown to cause sublethal (damaging, but not deadly), yet still significant, effects such as disorientation, slowed reaction time, and reduced feeding (Camargo et al. 2005).

Waters in the proposed ORW reach of the Gallatin River do not currently, at any time of the year, approach the recommended maximum nitrate concentrations that could cause measurable

sub-lethal problems in fish (BWTF 2006). Since each development is evaluated independently with regards to surface water impacts, there would be no mechanism to control the cumulative nutrient loading of the potential 652 SFEs under the No Action Alternative. These additional units could be added, and water quality could be allowed to decline slowly without any individual permit holder, community wastewater treatment system, or individual wastewater treatment system violating existing water quality standards.

Under the No Action Alternative, a development could apply for an application to degrade state waters. In addition, there is no numeric aquatic life criterion for nitrate, and the EPA maximum contaminant level for nitrate (as N) concentration in surface waters (10 mg/L) is considerably higher than Camargo et al.'s (2005) suggested limit, 2.0 mg/L (DEQ 2006a). Therefore, under the No Action Alternative, the Gallatin River could be allowed to approach or exceed 2.0 mg/L of nitrate without any required regulatory intervention by DEQ. With full build-out, levels of nitrate are likely to remain well below this threshold, assuming the 153 gpd effluent (Nicklin 2000a). Figure 4.3-5 shows that at 652 SFE the additional nitrate concentration would be less than 0.04 mg/L above the existing background levels. Figure 4.3-6 shows that background levels currently approach 1.0 mg/L at one of the BWTF monitoring sites, and that the background nitrate levels appear to be increasing (BWTF 2005). If full build-out was completed at current standards for nutrient loading, then nitrate levels could increase to 1.02-1.04 mg/L nitrate. These calculations assume no leakage from the Big Sky County Water and Sewer District and continued zero discharge from their facility. If conditions of the Big Sky County Water and Sewer District MPDES permit change, or if their facility infiltration rate increases, it is not unreasonable to assume that background nitrate levels will continue to increase and that total levels might approach the 2.0 mg/L threshold. This level of nitrate would not cause the recreational fishery to decline rapidly, but would be likely to adversely affect rainbow trout fry and eggs (Table 4.7-2) (Kincheloe et al. 1979). Since cold water temperature in the proposed ORW reach already limits rainbow trout growth, this added stress to the adults could also cause adverse effects on adult growth, reproduction, and survival (Crunkilton and Johnson 2000).

Table 4.7-1. Laboratory results for toxicity[a] of nitrate in aquatic organisms.

Species	Life stage	Exposure duration	Toxicity endpoint	Concentration (mg/L)	Reference
Fish					
Rainbow trout	Eggs	30 days	LOEC[b]	2.3	Camargo et al. 2005
	Fry	30 days	LOEC	2.3	Camargo et al. 2005
	Fingerlings	7 days	LC_{50}[c]	903.0	Westin 1974
Cutthroat trout	Eggs	30 days	LOEC	4.5	Camargo et al. 2005
	Fry	30 days	LOEC	7.6	Camargo et al. 2005
Catla (carp family)	Fry	24 hours	LC_{50}	1,484	Camargo et al. 2005
Amphibians					
Wood frog	Eggs	Not reported	Deformation	10.02	Laposata and Dunson 1998
Boreal chorus frog	Tadpoles	96 hours	LC_{50}	17.0	Camargo et al. 2005
	Tadpoles	100 days	LOEC	10.0	
Macroinvertebrates					
Water flea (*Daphnia magma)*	Adult	96 hours	LC_{50}	665	Dowden and Bennett 1965
Caddis fly (*Hydropsyche occidentalis)*	Larvae (early-to-late instars)	120 hours	Immobility	66.5 to 77.2	Camargo and Ward 1992

[a] Toxicity studies usually focus on defining the concentration that will kill a given percentage of a test population.
[b] LOEC = Lowest observed effect concentration.
[c] LC_{50} = The concentration that is lethal to 50% of the test organisms within the stated exposure time.

Table 4.7-2. Laboratory results for phosphorus toxicity[a] in aquatic organisms.

Species	Life stage	Exposure duration	Toxicity endpoint	Concentration (mg/L)	Reference
Fish					
Rainbow trout	Fingerlings (43 mm)	24 hours	LC_{50} [c]	0.061	Bentley et al. 1978
	Fingerlings (43 mm)	48 hours	LC_{50}	0.028	Bentley et al. 1978
	Fingerlings (43 mm)	96 hours	LC_{50}	0.022	Bentley et al. 1978
	Fingerlings (43 mm)	24 hours	LC_{50}	0.061	Bentley et al. 1978
Cutthroat trout		No data			
Fathead minnow (*Pimephales promelas*)	Fry (60 d post hatch)	24 hours	LC_{50}	0.025	Bentley et al. 1978
Macroinvertebrates					
Chironomidae (midges)	2-3 instar	24 hours	LC_{50}	0.24	Bentley et al. 1978
Chironomidae (midges)	2-3 instar	48 hours	LC_{50}	0.11	Bentley et al. 1978

[a] Toxicity studies usually focus on defining the concentration that will kill a given percentage of a test population.
[b] LOEC = Lowest observed effect concentration.
[c] LC_{50} = The concentration that is lethal to 50% of the test organisms within the stated exposure time.

In addition to the impacts on trout caused by increased nutrient concentrations, changes in the aquatic macroinvertebrate community (the food base for trout) would potentially reduce growth and the total carrying capacity of the proposed ORW reach. Carrying capacity is an estimate of the number of organisms (in this case, trout) that an ecosystem can support given the available food, shelter, and other ecological factors. If the trout carrying capacity of an aquatic ecosystem decreases, the total population of trout in that area is likely to decrease, or the existing population may experience reduced growth, increased competition, increased susceptibility to disease, or reduced reproduction success. If the food quantity or quality decreases, the total number of trout that can eat well enough to grow and thrive decreases.

The macroinvertebrate community shift would affect the total mass of food available for trout. Trout are size selective predators and tend to seek out larger-bodied prey when given a choice (Meissner and Muotka 2006). Bioenergetically, large prey are worth more energy to a fish and take less energy to catch than a calorically-equivalent number of smaller prey (Sherwood and Pazzia et al. 2002). Although midges would continue to be plentiful, hatches of larger-bodied caddis flies, mayflies, and stoneflies that instigate trout feeding frenzies might be reduced or occur less frequently. These hatches represent significant contributions to the trout’s annual caloric intake. Changes in food web structure have been shown to limit feeding opportunities in fish that can lead to stunting (Sherwood and Pazzia et al. 2002). Sherwood and Kovecses et al. (2002) studied food webs in polluted lakes where species diversity was reduced or where competition required fish to shift to smaller, less desirable prey. The study found that fish growth and final size were reduced, and hypothesized that reproductive success would be compromised as well as fish had fewer net calories available.

Impacts to the Recreational Fishery

If the trout population were to decline, the recreational fishery would also see reductions in angler satisfaction. Potentially, fewer anglers would make the Gallatin River a destination for their fishing trips. These declines are likely to lag behind the pace of development and subsequent increases in nutrient levels, as the first stages to experience negative impacts would be eggs and fry. The impacts to the “catchable” fish would not be observed until four or five years after the fishery first experiences any deleterious effects from lower water quality. Since Montana Fish, Wildlife and Parks conducts biennial trout surveys (Tohtz 2005b), reductions in “year-class strength” would probably be noticed before anglers observe a reduction in their fishing experience.

Each group of fish that hatch out in the same year are considered a year-class. As impacts to developing eggs and maturing fry increase, year class size may decrease. Rainbow trout are more susceptible to nitrate effects than cutthroat trout, so the few westslope cutthroat trout and Yellowstone cutthroat trout that may stray into the mainstem from tributaries where they reside are less likely to be affected (Table 4.7-1) (Camargo et al. 2005). The cold water temperatures in the Gallatin mainstem would help to prevent or minimize algal blooms, even if nutrient levels increase. Anglers are not likely to encounter rocks covered in slimy periphyton in the proposed ORW reach; however, as these nutrients flow downstream where water temperatures warm and biological activity increases, nuisance levels of algae may reduce angler and other recreationists’ satisfaction (Marcarelli 2005).

Impacts to the popular caddis fly, mayfly, and stonefly hatches could also affect the recreational fishery. Anglers may choose to fish alternative waters such as the Yellowstone and Madison rivers if the seasonal hatches on the Gallatin River are noticeably reduced. Relocation of angler activity would translate into relocation of associated tourism dollars.

4.7.1.3 Cumulative Impacts

Cumulative impacts to the Gallatin River's fishery resources due to the No Action Alternative would be exacerbated by shifts in the periphyton and macroinvertebrate communities as described under secondary impacts. Reasonably foreseeable actions that might intensify these impacts would include the potential for decreased surface water supply due to residential water use by those who occupy houses built inside the footprint. Any reduction in the total flow of the Gallatin River would reduce available habitat for fish, and diminish the overall dilution of nutrients entering the Gallatin River. As with all of the impacts discussed, the extent of this effect is difficult to quantify because it is subject to several interacting human factors. The overall cumulative impacts to the fishery would be commensurate with the intensity of future development under existing regulations and standards.

As mentioned in the aquatic resources discussion, DEQ is developing TMDLs for the South and West forks of the Gallatin River, which will include water quality restoration plans and prescriptions for reducing nonpoint source pollution in these watersheds. Any nutrient input reductions that the TMDL program can implement would potentially reduce the overall impact of the No Action Alternative, but because participation is voluntary, its potential for decreasing nonpoint source nutrient input is not dependable in the absence of a change in regulation by DEQ.

4.7.1.4 Mitigation

The fishery of the Gallatin River would be adversely impacted by increases in nutrient inputs to the proposed ORW reach, and indirectly by the cascading chemical and biological effects of nutrient increase in the aquatic ecosystem. As one of the upper-level predators in the Gallatin River food web, the impacts to trout would be magnified by changes to their food source. Once the nutrients are introduced into the river, there is little or nothing that can be done to rectify the impacts; therefore, mitigation should focus on avoiding, minimizing, and reducing nutrient sources. Mitigation of impacts to fisheries resources from all alternatives in this EIS will focus on reducing nutrient inputs to the proposed ORW reach. Section 4.3 discusses several types of septic treatment systems capable of reducing nutrient output from individual and community septic systems. Adoption of these septic treatment systems could reduce net nutrient input to the Gallatin River substantially.

Effective mitigation actions would most likely be the result of changes to regulation and policies related to residential development within the footprint. Actions that would mitigate impacts to fisheries resources due to the No Action Alternative would include the following within the footprint:

- Adoption of more stringent nutrient trigger values for effluent from development within the footprint

- Enforcement of water use limits during the summer season to reduce groundwater use from wells
- Incentive programs for, or regulations requiring, more efficient nutrient removing septic alternatives for new-home installation or replacement of existing septic systems.

4.7.2 Proposed Action Alternative

The preservation of existing water quality in the proposed ORW reach would benefit the fishery in that reach and in downstream reaches. Adoption of the Proposed Action Alternative would result in several positive impacts to the fishery within the proposed ORW reach as well as downstream of Spanish Creek. The current fishery thrives in the cold, relatively clean waters of the Gallatin River. Fish, macroinvertebrates, and algae, as described in the previous section, would be the organisms most directly affected by the change in management of the proposed ORW reach. The river water is the defining element of their habitat, constantly refreshing their oxygen and food supply. By preserving the water quality of the proposed ORW reach, the quantity and quality of fisheries resource would also be preserved.

4.7.2.1 Primary Impacts

As with the No Action Alternative, there will be minimal immediate measurable impacts to fisheries resources that have a direct cause and effect relationship with the Proposed Action Alternative. The effects will be due to a lack of water quality degradation over time, which is difficult to measure. However, when viewed as an alternative to the slow, but marked, decline in water quality under the No Action Alternative, the benefits of the Proposed Action Alternative are substantial. These impacts may be delayed due to biological processes, but that does not reduce or nullify their connection to the Proposed Action Alternative.

4.7.2.2 Secondary Impacts

Under the Proposed Action Alternative, DEQ would manage the proposed ORW reach to preserve existing water quality. This preservation of water quality means that new developments proposed within the footprint would need to meet the nutrient loading guidelines (See Appendix A). Overall, the result of this new regulation would mean the existing nutrient load carried by the proposed ORW reach would not measurably increase over time as a result of wastewater discharges. Other factors and sources could lead to increased nutrient loads in the river. Current water quality in the proposed ORW reach is very good, with nutrient levels consistent with oligotrophic systems (Armantrout 1998, BWTF 2006). Macroinvertebrates that thrive in unpolluted, oligotrophic systems include several relatively large-bodied orders such as mayflies, caddis flies, and stoneflies. These orders are also good sources of calories for trout, especially when large hatches occur, and anglers make good use of this information in their attempts to catch fish in the proposed ORW reach. Small-bodied midges are plentiful throughout the year and support trout because of their consistent availability. The concern for a macroinvertebrate community shift arises when the midges substantially replace other orders, and the trout's food supply is less diverse and potentially less nutritious. In addition, a midge-dominated macroinvertebrate community is indicative of poor water quality and potentially stressful conditions for sensitive species such as trout.

Under the Proposed Action Alternative, the current macroinvertebrate community would be likely to persist and provide a consistent food base for the rainbow trout populations. Annual hatches of mayflies, caddis flies, and stoneflies would continue at current levels, and trout would benefit from this important seasonal food source.

Impacts to the Recreational Fishery

Under the Proposed Action Alternative, anglers would continue to come to the Gallatin River to fish the "blue ribbon" fishery. It is conceivable that angler use may increase in the short term if publicity of the ORW designation entices more anglers to the Gallatin River. Angler satisfaction would be likely to remain high and may even increase with the cachet of ORW status.

4.7.2.3 Cumulative Impacts

Cumulative impacts of the Proposed Action Alternative would include continued maintenance of the existing high quality fishery based on preservation of the current water quality and the supporting aquatic habitat. The ongoing TMDL programs may also reduce nutrient loading as mentioned in the No Action Alternative discussion of cumulative impacts. However, these reductions are not mandatory. The Proposed Action Alternative would most likely reduce the maximum development potential for the Big Sky area because of the more stringent nutrient loading criteria within the footprint. The Proposed Action Alternative could also result in larger community wastewater treatment systems outside the vulnerability footprint and higher density housing within the footprint area. Reductions in total future numbers of residential or community wells would help to maintain the existing groundwater level. Any action that helps to maintain overall water availability in the Gallatin watershed would benefit the health and vigor of the aquatic environment and the trout fishery.

4.7.2.4 Mitigation

There would be no negative impacts to fisheries resources due to adoption of the Proposed Action Alternative; therefore, no mitigation of impacts would be necessary.

4.7.3 Cumulative Impacts Analysis Alternative

The Cumulative Impacts Analysis Alternative is similar to the Proposed Action Alternative in that it would assess each new potential nutrient source in the context of current and past nutrient inputs to proposed ORW reach. The assessment of new developments in the context of existing water quality in the proposed ORW reach may benefit the fishery in that reach and in downstream reaches. Adoption of the Cumulative Impacts Analysis Alternative could result in positive impacts to the fishery similar to those described for the Proposed Action Alternative within the proposed ORW reach as well as downstream of Spanish Creek.

4.7.3.1 Primary Impacts

As with the other alternatives discussed above, there will be minimal immediate measurable impacts to fisheries resources that have a direct cause and effect relationship with the Cumulative Impacts Analysis Alternative. The effects will be due to a lack of water quality degradation over time, which is difficult to measure. However, when viewed as an alternative to the slow, but marked, decline in water quality under the No Action Alternative, the benefits of the Cumulative

Impacts Analysis Alternative are significant. These impacts may be delayed due to biological processes, but that does not reduce or nullify their connection to the Cumulative Impacts Analysis Alternative.

4.7.3.2 Secondary Impacts

Under the Cumulative Impacts Analysis Alternative, DEQ would assess potential point sources of pollutants to the proposed ORW reach in the context of existing and past permitted sources. This evaluation of water quality means that the incremental impact of new developments proposed within the footprint would need to remain below nutrient loading guidelines (See Section 4.3). Overall, the result of this new regulation would mean the existing nutrient load carried by the proposed ORW reach would not exceed DEQ's trigger values as a result of wastewater discharges. Other factors and sources could lead to increased nutrient loads in the river.

Current water quality in the proposed ORW reach is very good, with nutrient levels consistent with oligotrophic systems (Armantrout 1998, BWTF 2006). Water quality in some of the major tributaries to the Gallatin River is impaired, and nutrient inputs from these tributaries should be included in the characterization of existing conditions within the proposed ORW reach. Secondary impacts due to the adoption of the Cumulative Impacts Analysis Alternative could stem from the ability to apply the narrative standard or pursue permission to degrade would allow potential degradation of water quality if DEQ were to grant applications under these avenues. However, since each new input would be added to the existing nutrient load baseline, eventually there would be no more capacity for new nutrient sources. When nutrient loading capacity is reached, the Cumulative Impacts Analysis Alternative would begin to be administered perhaps even more stringently than the Proposed Action Alternative.

Under the Cumulative Impacts Analysis Alternative, the current macroinvertebrate community would be likely to persist and provide a consistent food base for the rainbow trout populations. Annual hatches of mayflies, caddis flies, and stoneflies would continue at current levels, and trout would benefit from this important seasonal food source. Seasonal spikes in nutrients may impact macroinvertebrates and, consequently, fish; but if the Cumulative Impacts Analysis Alternative is consistently administered, these should diminish over time.

Impacts to the Recreational Fishery

Under the Cumulative Impacts Analysis Alternative, anglers would continue to come to the Gallatin River to fish the "blue ribbon" fishery. It is unlikely that implementation of this alternative would affect numbers of recreational anglers or their level of satisfaction.

4.7.3.3 Cumulative Impacts

Cumulative impacts of the Cumulative Impacts Analysis Alternative would likely include maintenance of the existing high quality fishery based on limited and sporadic impacts to current water quality and the supporting aquatic habitat. As mentioned above, the ongoing TMDL programs may also reduce nutrient loading. However, these reductions are not mandatory. The Cumulative Impacts Analysis Alternative would most likely reduce the maximum development potential for the Big Sky area because of the potential incrementally more stringent nutrient loading criteria within the footprint. As the available nutrient loading is allocated, subsequent

developments will have to meet more stringent criteria. Similar to the Proposed Action Alternative, the Cumulative Impacts Analysis Alternative could also result in larger community wastewater treatment systems outside the vulnerability footprint and higher density housing within the footprint area. Reductions in total future numbers of residential or community wells would help to maintain the existing groundwater level. Any action that helps to maintain overall water availability in the Gallatin watershed would benefit the health and vigor of the aquatic environment and the trout fishery.

Impacts to the Recreational Fishery

It is unlikely that implementation of the Cumulative Impacts Analysis Alternative would affect trout populations in a manner substantially different from the Proposed Action Alternative. Both alternatives result in more stringent evaluation of water quality than the No Action Alternative and potential reductions in nutrient sources over time. This increased level of water quality management would protect the resident fishery from chronic increases in pollutants due to wastewater discharge, currently the most significant pollutant source identified in the proposed ORW reach.

4.7.3.4 Mitigation

Impacts to the Gallatin River fishery resulting from the Cumulative Impacts Analysis Alternative may include seasonal spikes in nutrient levels and potential overshooting of DEQ-specified nutrient trigger values. Once the nutrients are introduced into the river, there is little or nothing that can be done to rectify the impacts; therefore, mitigation should focus on avoiding, minimizing, and reducing nutrient sources. Mitigation of impacts to fisheries resources from all alternatives in this EIS will focus on reducing nutrient inputs to the proposed ORW reach. Section 4.3 discusses several types of septic treatment systems capable of reducing nutrient output from individual and community septic systems. Adoption of these septic treatment systems could reduce net nutrient input to the Gallatin River substantially.

Effective mitigation actions would most likely be the result of changes to regulation and policies related to residential development within the footprint. Actions that would mitigate impacts to fisheries resources due to the Cumulative Impacts Analysis Alternative would include the following within the footprint:

- Consistent monitoring and feedback regarding observed levels of nutrients in the Gallatin River (monitoring should be at a resolution capable of evaluating seasonal changes as well as tracking incremental changes with increased development)
- Regular incorporation of monitoring results into planning and permit evaluation
- Enforcement of water use limits during the summer season to reduce groundwater use from wells
- Incentive programs for, or regulations requiring, more efficient nutrient removing septic alternatives for new-home installation or replacement of existing septic systems.

4.8 Terrestrial Vegetation and Habitats

Vegetation resources will not be directly impacted by the regulatory changes proposed under the Proposed Action Alternative; however, the potential for clearing of vegetation as the result of development within the study area is examined as a method of comparing the No Action and Proposed Action alternatives.

4.8.1 No Action Alternative

4.8.1.1 Primary Impacts

For plants and their habitats, there would be minimal immediate measurable impacts that have a direct cause and effect relationship with the No Action Alternative. The No Action Alternative would retain the pace and extent of existing development, but, if adopted, would not cause an immediate on-the-ground change. The rate and extent of development is pertinent to the terrestrial environment because the amount of ground disturbance would potentially increase with development.

4.8.1.2 Secondary Impacts

The No Action Alternative effects on vegetation would be gradual and controlled by the scale and rate of human activity, such as the amount of residential development and the number of new roads within the study area. Secondary vegetative impacts would stem almost exclusively from ongoing development activities involving vegetative disturbance or clearing. This clearing includes the loss of vegetation for up to 652 new dwelling units and up to 419,000 square feet of commercial and community facilities on privately owned lands in Low and Moderate Cover Dry Grassland, Sagebrush Shrubland, Graminoid and Forb Riparian, Shrub Riparian, and Mixed Riparian vegetative community types (see Section 4.4.2). Ground disturbance for the development of permanent structures (homes, businesses, roads, etc.) would result in permanent loss of vegetation. Other vegetative disturbances may be short term if areas are revegetated with native species (e.g., ground disturbance for septic tanks, yards, etc.). For noxious weeds, the removal of existing weed biomass and seed source may be a beneficial impact.

Secondary impacts would be most prevalent on private lands currently undeveloped or partially developed but zoned for additional development. Native plant communities may be permanently altered or replaced with non-native species, creating fragmented native habitat. Revegetated areas would require time for vegetation to reestablish. The impacts to vegetation may be temporary for grass and forb species, which can be reseeded and grow quickly, and for shrub species that can recolonize relatively quickly. Natural re-establishment of trees would be slow, especially in moderately high altitude/short growing season areas around Big Sky.

Species of Concern

Six vascular plant species of concern have occurrences either within the study area footprint or within 10 miles of the footprint (Table 3.8-3) (MNHP 2006a). These species would be affected to different degrees. The No Action Alternative would not impact English sundew because it does not occur in the footprint and it is unlikely that suitable habitat occurs in the study area. Small-winged sedge occurs five miles from the study area boundary and would not be impacted by the No Action Alternative. The known location of Hall’s rush one half mile west of the study

area footprint and the potential suitable habitat within the footprint are on private property under a conservation easement. Therefore, Hall's rush habitat should not be affected by future development. Known threats to large-leafed balsamroot include off-trail horse and bike riding that can lead to erosion and mechanical damage to this species habitat (MNHP 2006a). This species occurs on the Gallatin National Forest one mile from the study area adjacent to a recreational trail. Although off-trail travel could have an impact, future development would not have an impact. Restrictions to off-trail travel are a function of the Gallatin National Forest's recreation management plans, and these regulations would not be altered by the No Action Alternative. There would be no impact on discoid goldenweed by future development (land use change) or direct removal related to the No Action Alternative because it occurs on public lands where development is unlikely (M. Story pers. comm. 2006).

Annual Indian paintbrush would be impacted by future development because it occurs on private lands that are partially developed. Primary impacts include the potential removal of annual Indian paintbrush plants.

Distribution and abundance of Hall's rush, large-leafed balsamroot, annual Indian paintbrush, and discoid goldenweed could also suffer from increased invasion of noxious weeds. Weeds have been documented in the vicinity of all these species of concern. Of particular risk would be locations adjacent or near to roads or trails where weeds have a greater likelihood of spread. Secondary impacts from noxious weeds on these species of concern include potential increased competition, displacement (Sheley and Petroff 1999), and plant damage or mortality resulting from off-target herbicide impacts during noxious weed management (e.g., herbicide drift).

Annual Indian paintbrush may be vulnerable to hydrologic alterations (MNHP 2006a). If the water table is lowered by an increased number of wells with further development within the footprint (see Section 4.3), annual Indian paintbrush could be harmed, particularly where it occurs on private land near Big Sky. The degree of impact is unknown.

Noxious Weeds

If revegetation efforts after development replace existing noxious weed species with more favorable species, the changes in plant community composition and structure may be beneficial. If, as commonly occurs, development spreads weed seed to new areas, weeds may become a problem on additional private and public lands. As ground disturbances associated with development increase, the potential for weed spreading increases. Consequently, weed proliferation reduces desired vegetation, such as native plant communities. Noxious weeds, including Canada thistle, spotted knapweed, and houndstongue, occur primarily along the roadways and waterways and are prevalent noxious weed species in the study area (Kellar 2006, USDA Forest Service 2002, 2005c). The entire study area is suitable habitat for these weeds. The impact of noxious weeds would depend on future disturbances and surrounding vegetative community types. Future development has the potential to increase the area and density of the noxious weed infestations because weeds tend to occur in disturbed areas (e.g., residential or commercial development), as well as along moving water (Gelbard and Belnap 2003, Larson 2003, Tyser and Worley 1992). In addition, several studies have found that soil brought in for construction may provide better habitat for weeds than native soil (Gelbard and Belnap 2003, Greenberg et al. 1997, Wester and Jurvik 1983). If noxious weed populations are adjacent to

grassland or shrubland community types, they are more likely to spread than if they are adjacent to forest communities (Rew et al. 2001). In the ORW study area, most noxious weed locations occur in the Low and Moderate Cover Dry Grassland vegetation community type, a community type where they can readily spread.

4.8.1.3 Cumulative Impacts

Removal of vegetation within the riparian zone, primarily from private land development, may cause cumulative impacts on water catchment, infiltration, and delivery from rain events. These changes in soil water content and water availability would generally negatively affect vegetation but may benefit some noxious weeds. Depending upon the zoning district, riparian areas may be protected from disturbance by water body setbacks. These setbacks vary from 100 to 300 feet.

Species of Concern

Cumulative impacts on species of concern for the No Action Alternative vary by species. Because exact locations and extent of ground disturbances cannot be known at this time, it is difficult to make definitive impact determinations on specific plants or communities. If Hall's rush and large-leafed balsamroot are impacted, their ability to persist in Gallatin County may be reduced. The viability of these species in Montana and their global range would not be impacted under the No Action Alternative. Discoid goldenweed is known from only two locations in Montana (MNHP 2006a). Potential secondary impacts caused by area development and other ground disturbances could increase its vulnerability to extinction in Montana. On a global range, discoid goldenweed's viability would not be affected. Any loss in abundance or habitat for annual Indian paintbrush would probably not affect its ability to persist in Gallatin County.

Noxious Weeds

Cumulative impacts of noxious weed spread may include declines in native plant community diversity (Kedzie-Webb et al. 2001), increased sedimentation (Lacey et al. 1989), and decreased wildlife or livestock forage (Rice et al. 1997).

4.8.1.4 Mitigation

The overarching impacts from the No Action Alternative are the removal of native vegetation and potential increases in noxious weed quantity, composition, and distribution from development. Mitigation measures would take the form of revegetation techniques and noxious weed management.

Recommended mitigation measures include:

- Revegetate disturbed areas, including residential areas, only with native species.
- Use only certified weed free seed in revegetation activities.
- Limit surface disturbance to immediate development area and avoid clearing entire sites.
- Plan future developments to minimize removal and fragmentation of native habitats.
- Clear existing vegetation only from areas scheduled for immediate construction work and only for the area needed for active construction activities.
- Weed management should occur throughout the study area by public and private land owners. Affected individuals are reminded to comply with the Montana Noxious Weed Law,

follow the requirements of the Noxious Weed Management Act, Title 7, Chapter 22, Part 21, and comply with the Gallatin County and Gallatin National Forest noxious weed control requirements. These management plans are thorough and should be followed carefully.
- Increase noxious weed identification and management education opportunities for private land owners.
- Increase efforts to map and spot-treat weed infestations throughout the study area.
- Clean construction equipment (e.g., power wash) prior to entering the project area and before leaving the project area.
- Avoid directly disturbing (removing) species of concern during development and use caution when using herbicides near known occurrences.

4.8.2 Proposed Action Alternative

4.8.2.1 Primary Impacts

There would be minimal immediate measurable impacts to plants and their habitats that have a direct cause and effect relationship with the Proposed Action Alternative. The Proposed Action Alternative might slow the pace and extent of development, but mitigations to wastewater systems would make the same level of development possible. Although impacts may be delayed due to biological processes that move more slowly than development, it does not reduce or nullify their connection to the Proposed Action Alternative. The rate of development is pertinent to the terrestrial environment because the amount of ground disturbance will probably be decreased if development is decreased.

4.8.2.2 Secondary Impacts

Effects of the Proposed Action Alternative on vegetation would be gradual, and controlled by the scale and rate of human activity, such as residential development and the number of new roads within the study area. Secondary vegetative impacts would stem almost exclusively from ongoing development activities involving vegetative disturbance or clearing. The type of adverse secondary vegetative impacts (although not the degree, as discussed below) under the Proposed Action Alternative would be the same as the No Action Alternative, but the magnitude of effect might be lessened. Impacts would include:

- Removal of vegetation due to future development, particularly on privately owned lands of Low and Moderate Cover Dry Grassland, Sagebrush Shrubland, Graminoid and Forb Riparian, Shrub Riparian, and Mixed Riparian vegetative community types. The ground disturbance for the development of permanent structures (homes, businesses, roads, etc.) would result in permanent loss of vegetation.
- Short-term vegetation removal during development (e.g., ground disturbance for septic tanks, yards, etc.).
- The removal for noxious weed biomass and seed source.

While the types of vegetation impacts are the same as the No Action Alternative, the degree to which they affect vegetation would be less, assuming the use of conventional septic tank and drainfield wastewater management systems. Under the Proposed Action Alternative, vegetation

loss would occur for about 75 new dwelling units and up to 3,233 square feet of commercial and community facilities (see Section 4.4.3), a reduction of 87% and 99% from the No Action Alternative. Therefore, while vegetation removal would occur under the Proposed Action Alternative, the amount of vegetation removed might be reduced commensurate with the reduction in overall development. However, with mitigation development rates could be similar to those under the No Action Alternative, and thus vegetation removal and impact would be similar.

As with the No Action Alternative, the secondary impacts on vegetation for the Proposed Action Alternative would be most prevalent on private lands that are undeveloped or partially developed but zoned for additional development. Native plant communities may be permanently altered or replaced with non-native species, creating fragmented native habitat. Revegetated areas would require recolonization time. These impacts may be reduced under the Proposed Action Alternative if less development occurs.

Species of Concern

In general impacts under the Proposed Action Alternative would be similar to those noted in the previous section. However, because more stringent water quality standards under the Proposed Action Alternative could limit the number of future dwelling units and commercial properties, direct impacts to annual Indian paintbrush are less likely to occur under the Proposed Action Alternative than under the No Action Alternative. If the mitigations described in Section 4.3.2 are implemented, then the level of ground disturbance may not be significantly different under either alternative. In this instance, primary impacts to annual Indian paintbrush would be the same as under the No Action Alternative.

Noxious Weeds

In general impacts to noxious weeds under the Proposed Action Alternative would be similar to those noted under the No Action Alternative. Because less ground disturbance would occur under the Proposed Action Alternative than under the No Action Alternative due to the reduced number of dwelling units, the secondary impact of noxious weed spread may also be lower.

The habitats of Hall’s rush, large-leafed balsamroot, annual Indian paintbrush, and discoid goldenweed, which occur in or adjacent to the study area, could experience secondary impacts from noxious weed spread under the Proposed Action Alternative. Because these occurrences are next to existing roads and trails, the degree of secondary impacts would be the same as under the No Action Alternative.

Annual Indian paintbrush may be vulnerable to hydrologic alterations (MNHP 2006a), if groundwater elevations are reduced due to an increased number of wells (see Section 4.3). The degree of impact is unknown but is likely less than in the No Action Alternative because the number of wells may be less under the Proposed Action Alternative.

4.8.2.3 Cumulative Impacts

While the type of cumulative vegetation impacts for the Proposed Action Alternative would be the same as the No Action Alternative, the degree to which they affect vegetation may be lower because of the potential for decreased development under this alternative.

While some additional protection of vegetation is implied under the Proposed Action Alternative because less vegetation may be directly removed or altered, the Proposed Action Alternative does not necessarily guarantee the persistence of native species or species of concern, nor does it prevent noxious weed spread. The impacts of weeds in the study area would be largely dependent on the level of on-going management. The Proposed Action Alternative will not have a direct impact on management activities for plant communities regulated by private and public landowners, nor would it affect the treatment of weeds with herbicides within the footprint. Herbicides, when used according to safety regulations and restrictions, are not regulated under the National Pollutant Discharge Elimination System (Clean Water Act) or Montana Water Quality Act as point source discharges (T. Reid, pers. comm. 2006, DEQ 2005d, Grumbles and Hazen 2005).

Cumulative impacts would include:

- Loss of habitat, primarily on private lands.
- Fragmentation of these plant communities which could impact overall plant productivity and wildlife use.
- Fragmentation of vegetation which could also impact the size of habitat patches, proximity of habitat patches, and increase the amount of habitat edge. These factors ultimately impact the quality of habitat for birds and mammals (Stephens et al. 2003).
- Removal of vegetation within the riparian zone, again primarily from private land development, which may cause cumulative impacts on water catchment, infiltration, and delivery from rain events.
- Possible declines in native plant community diversity due to noxious weed spread (Kedzie-Webb et al. 2001), increased sedimentation (Lacey et al. 1989), and decreased wildlife or livestock forage (Rice et al. 1997).
- Possible extirpation within Gallatin County of Hall’s Rush and Large-leafed balsamroot, but the viability of these species in Montana and their global range would not be impacted.
- A possible increase in discoid goldenweed vulnerability of extinction in Montana due to secondary impacts, but not its global viability.

4.8.2.4 Mitigation

The mitigation measures for vegetation resources would not change from the No Action Alternative as a result of implementing the Proposed Action Alternative. See Section 4.8.1.4 for a list of recommended measures.

4.8.3 Cumulative Impacts Analysis Alternative

4.8.3.1 Primary Impacts

There would be minimal immediate measurable impacts to plants and their habitats that have a direct cause and effect relationship with the Cumulative Impacts Analysis Alternative. The Cumulative Impacts Analysis Alternative might slow the pace and extent of development, but mitigations to wastewater systems would make the same level of development possible. Although impacts may be delayed due to biological processes that move more slowly than

development, it does not reduce or nullify their connection to the Cumulative Impacts Analysis Alternative. The rate of development is pertinent to the terrestrial environment because the amount of ground disturbance will probably be decreased if development is decreased.

4.8.3.2 Secondary Impacts

Effects of the Cumulative Impacts Analysis Alternative on vegetation would be gradual, and controlled by the scale and rate of human activity, such as residential development and the number of new roads within the study area. Secondary vegetative impacts would stem almost exclusively from ongoing development activities involving vegetative disturbance or clearing. The type of adverse secondary vegetative impacts (although not the degree, as discussed below) under the Cumulative Impacts Analysis Alternative would be the same as the No Action Alternative, but the magnitude of effect might be lessened. Impacts would include:

- Removal of vegetation due to future development, particularly on privately owned lands of Low and Moderate Cover Dry Grassland, Sagebrush Shrubland, Graminoid and Forb Riparian, Shrub Riparian, and Mixed Riparian vegetative community types. The ground disturbance for the development of permanent structures (homes, businesses, roads, etc.) would result in permanent loss of vegetation.
- Short-term vegetation removal during development (e.g., ground disturbance for septic tanks, yards, etc.).
- The removal for noxious weed biomass and seed source.

While the types of vegetation impacts are the same as the No Action Alternative, the degree to which they affect vegetation would be less, assuming the use of conventional septic tank and drainfield wastewater management systems. Under the Cumulative Impacts Analysis Alternative, vegetation loss would occur for 75 new dwelling units and up to 3,233 square feet of commercial and community facilities (see Section 4.4.3), a reduction of 87% and 99% from the No Action Alternative. Therefore, while vegetation removal would occur under the Cumulative Impacts Analysis Alternative, the amount of vegetation removed might be reduced commensurate with the reduction in overall development. However, with mitigation development rates could be similar to those under the No Action Alternative, and thus vegetation removal and impact would be similar.

As with the No Action Alternative, the secondary impacts on vegetation for the Cumulative Impacts Analysis Alternative would be most prevalent on private lands that are undeveloped or partially developed but zoned for additional development. Native plant communities may be permanently altered or replaced with non-native species, creating fragmented native habitat. Revegetated areas would require recolonization time. These impacts may be reduced under the Cumulative Impacts Analysis Alternative if less development occurs.

Species of Concern

In general impacts under the Cumulative Impacts Analysis Alternative would be similar to those noted in the previous section for the No Action Alternative and the Proposed Action Alternative. However, because more stringent review of new developments and their wastewater systems under the Cumulative Impacts Analysis Alternative could limit the number of future dwelling units and commercial properties, direct impacts to annual Indian paintbrush are less likely to

occur under the Cumulative Impacts Analysis Alternative than under the No Action Alternative. If the mitigations described in Section 4.3.2 are implemented, then the level of ground disturbance may not be significantly different under either alternative. In this instance, primary impacts to annual Indian paintbrush would be the same as under the No Action Alternative.

Noxious Weeds

In general impacts to noxious weeds under the Cumulative Impacts Analysis Alternative would be similar to those noted under the No Action Alternative. Because less ground disturbance might occur under the Cumulative Impacts Analysis Alternative than under the No Action Alternative due to the reduced number of dwelling units, the secondary impact of noxious weed spread may also be lower.

The habitats of Hall's rush, large-leafed balsamroot, annual Indian paintbrush, and discoid goldenweed, which occur in or adjacent to the study area, could experience secondary impacts from noxious weed spread under the Cumulative Impacts Analysis Alternative. Because these occurrences are next to existing roads and trails, the degree of secondary impacts would be the same as under the No Action Alternative.

Annual Indian paintbrush may be vulnerable to hydrologic alterations (MNHP 2006a) if groundwater elevations are reduced due to an increased number of wells (see Section 4.6.1.4). The degree of impact is unknown but is likely less than in the No Action Alternative because the number of wells may be less under the Cumulative Impacts Analysis Alternative.

4.8.3.3 Cumulative Impacts

While the type of cumulative vegetation impacts for the Cumulative Impacts Analysis Alternative would be the same as the No Action Alternative, the degree to which they affect vegetation may be lower because of the potential for decreased development under this alternative.

While some additional protection of vegetation is implied under the Cumulative Impacts Analysis Alternative because less vegetation may be directly removed or altered, the Cumulative Impacts Analysis Alternative does not necessarily guarantee the persistence of native species or species of concern, nor does it prevent noxious weed spread. The impacts of weeds in the study area would be largely dependent on the level of on-going management. The Cumulative Impacts Analysis Alternative will not have a direct impact on management activities for plant communities regulated by private and public landowners, nor would it affect the treatment of weeds with herbicides within the footprint. Herbicides, when used according to safety regulations and restrictions, are not regulated under the National Pollutant Discharge Elimination System (Clean Water Act) or Montana Water Quality Act as point source discharges (T. Reid, pers. comm. 2006, DEQ 2005d, Grumbles and Hazen 2005).

Cumulative impacts would be the same as those under the Proposed Action.

4.8.3.4 Mitigation

The mitigation measures for vegetation resources would not change from the No Action Alternative as a result of implementing the Cumulative Impacts Analysis Alternative. See Section 4.8.1.4 for a list of recommended measures.

4.9 Wildlife Resources

4.9.1 No Action Alternative

Wildlife could be indirectly affected by the No Action Alternative in two ways: by the potential degradation of water quality over time (primarily an increase in phosphorus and nitrogen), and by habitat losses and disturbance created by increased development within the footprint.

Under the No Action Alternative, the Gallatin River would continue to be protected by current water quality laws, including existing state and federal surface water quality standards and nondegradation policy; but, despite these controls, there would continue to be nutrient increases in the river associated with increased development. As discussed in Chapter 2 and Section 4.3 (Water Quality), nondegradation review is conducted on a case-by-case basis with no cumulative effects analysis in the surface water. The potential for overall degradation of water quality exists. In addition, there are specified circumstances for which DEQ may allow degradation of water quality (Chapter 2). Continued implementation of current DEQ policy may result in an increase in nutrients in the river. As stated in Section 4.4 (Land Use) the Proposed Action Alternative could result in 89% less allowable dwelling units and 99% less commercial square footage within the footprint than under the No Action Alternative as written.

4.9.1.1 Primary Impacts

There would be no primary effect on wildlife resulting from the No Action Alternative. Changes in water quality and increased development would occur gradually over time, with any subsequent secondary adverse impacts on wildlife in the future.

4.9.1.2 Secondary Impacts

Secondary impacts to wildlife could occur if the No Action Alternative results in either degraded water quality over time or increased development, or both. It would not likely affect any federally listed wildlife species in the short term because water quality would continue to be managed under current laws. Bald eagles could be negatively affected if the No Action Alternative results in degraded water quality and a reduction in their prey base. Grizzly bears could be affected by increased human development and use in bear habitat. Effects to wolves or lynx are not likely to be measurable.

The effect of increased nutrient loading in the Gallatin River on aquatic life is discussed in detail in Sections 4.6 and 4.7. To the extent that increased eutrophication reduces fish or invertebrate productivity or changes species composition, piscivorous (fish-eating; for example, river otter, bald eagle, osprey, or mergansers) or insectivorous (insect-eating; for example, shrews, swallows, or warblers) wildlife may be affected by a change in prey base.

Approximately 10%, or 1,874 acres, of land in the footprint is private land that is either partially developed or undeveloped. Essentially, that is the land that has potential for increased development under the No Action Alternative. Under current zoning ordinances, there is potential for an additional 652 dwelling units and 419,000 square feet of commercial and community facilities (Section 4.4, Land Use).The majority of the developable private land is in

the Gallatin Canyon/Big Sky Zoning District, followed by an approximately 4-mile-long strip of land along the Gallatin River south of the Spanish Creek confluence. Habitat types affected are primarily grassland, xeric shrubland, coniferous forest, with a lesser amount of agricultural land and riparian habitat.

Increased development under this alternative could affect wildlife through habitat loss, habitat fragmentation, and increased disturbance by humans. The area around the confluence with the West Fork of the Gallatin River has the greatest amount of potential development under current conditions. This area provides summer and winter range for big game species; therefore, loss of this habitat could negatively affect big game.

The fragmentation of plant communities could be detrimental to overall plant productivity and wildlife use. Habitat fragmentation occurs when continuous areas of good quality habitat are broken up by home lots, transportation corridors, or other human use. For example, Hansen and Rotella (2002) studied nest success in an area around Yellowstone National Park and found success was lower for yellow warblers in areas with more intense human use. Fragmentation can also have an impact on the size and proximity of habitat patches and can increase the amount of habitat edge. These factors ultimately affect the quality of habitat for birds and mammals (Stephens et al. 2003).

Higher density development translates to more disturbance to wildlife through traffic, domestic pets, and general human activity. Development and subsequent accessibility to garbage is one of the leading causes of mortality of grizzly bears (D. Brewer, pers. comm. 2006).

4.9.1.3 Cumulative Impacts

Habitat losses from increased development allowed under the No Action Alternative, combined with other habitat losses and increased human encroachment on wildlife habitat in the region may cumulatively affect wildlife by reducing long-term population viability. Species that are less compatible with humans (such as grizzly bear) or those requiring larger areas of contiguous habitat are more likely to be affected.

4.9.1.4 Mitigation

Impacts to wildlife from reduced water quality could be mitigated by using alternative approaches to wastewater management/treatment as discussed in sections 4.3 and 4.7. Impacts from increased development density could be reduced by changing current zoning so that development would be less dense or by identifying key wildlife use areas and avoiding development in these areas. Effects to grizzly bears from human-induced interactions could be mitigated by implementing policies about food and garbage storage.

4.9.2 Proposed Action Alternative

4.9.2.1 Primary Impacts

There would be no immediate change in water quality or land use under the Proposed Action Alternative. Therefore, the Proposed Action Alternative would have no primary impacts on wildlife.

4.9.2.2 Secondary Impacts

Secondary impacts to wildlife from the Proposed Action may be beneficial as compared to the existing trends of development and water quality degradation. The Proposed Action represents the potential for an overall 89% (Section 4.4, Land Use) reduction in allowable dwelling units and 99% reduction in commercial footage; this reduced build-out potential represents less habitat loss, as well as long term protection of water quality.

The Proposed Action Alternative would not adversely affect any federally listed wildlife species, and may have beneficial effects. If it results in a lower density of dwelling units in the footprint, loss of habitat and human disturbance would be less than under the No Action Alternative. Preservation of water quality would be beneficial to bald eagles and more indirectly to the other species.

The mitigations proposed in Section 4.4 would make the build-out potential nearly identical to that under the No Action Alternative. The increase in build-out would nullify the benefits to wildlife due to reduced land use in the riparian area encompassed by the footprint.

4.9.2.3 Cumulative Impacts

Any cumulative impacts would be beneficial relative to the No Action Alternative.

4.9.2.4 Mitigation

No mitigation would be required since all impacts would be beneficial.

4.9.3 Cumulative Impacts Analysis Alternative

4.9.3.1 Primary Impacts

There would be no immediate change in water quality or land use under the Cumulative Impacts Analysis Alternative. Therefore, similar to the No Action and Proposed Action Alternatives, the Cumulative Impacts Analysis Alternative would have no primary impacts on wildlife.

4.9.3.2 Secondary Impacts

Secondary impacts to wildlife from the Cumulative Impacts Analysis Alternative, as in the Proposed Action Alternative, may be beneficial as compared to the existing trends of development and water quality degradation. However, unlike the Proposed Action Alternative, the Cumulative Impacts Alternative would retain two options under existing regulations for landowners and developers whose projects would cause exceedance of the pollutant trigger values and thus fail a nondegradation review. These options are: A) request review under DEQ’s narrative standard; and B) application for approval to degrade (see Section 2.2.1 for explanations of both options). If these options were pursued, it is possible they would result in a greater amount of development, and thus potentially greater wildlife habitat loss, than under the Proposed Action. It is not possible to identify where this would occur, and thus further refine potential loss of wildlife habitat. However, as noted in Section 4.4 (Land Use), it is likely that total future development within the footprint would be still be limited (unless alternative

wastewater systems are used) to intensities much closer to those defined for the Proposed Action than those expected under the No Action Alternative.

Because the Cumulative Impacts Analysis Alternative favors those applying for permits earlier over those waiting, it is likely this alternative would result in a brief spike in development activity within the footprint compared to the Proposed Action Alternative. It is not possible to predict where within the footprint this spike would occur or what type of development would be involved. Therefore, impacts to wildlife from development described under the Proposed Action Alternative may occur at an earlier point in time under the Cumulative Impacts Analysis Alternative.

As with the Proposed Action Alternative, the mitigations proposed in Section 4.4 would make the build-out potential nearly identical to that under the No Action Alternative. The increase in build-out would nullify the benefits to wildlife due to reduced land use in the riparian area encompassed by the footprint.

4.9.3.3 Cumulative Impacts

Any cumulative impacts would be beneficial relative to the No Action Alternative, and similar to the Proposed Action. However, as discussed in Section 4.3, the Cumulative Impacts Analysis Alternative may encourage the use of community or regional wastewater treatment systems and ultimately lead to development that is as dense or denser than under the No Action Alternative, and thus lead to wildlife habitat loss as great as or greater than under the No Action Alternative.

Due to the administrative (rather than legislative) nature of the Cumulative Impacts Analysis Alternative, DEQ could cease cumulative impacts analysis, return to current regulatory practices, and the impacts would be more similar to the No Action Alternative.

4.9.3.4 Mitigation

To the extent that any of the impacts discussed above would make the Cumulative Impacts Analysis Alternative more like the No Action Alternative, mitigation measures for wildlife as described under the No Action Alternative could be employed.

It is also possible that no mitigation would be required if impacts were similar to the Proposed Action, since all impacts would be beneficial.

4.10 Air Quality

4.10.1 No Action Alternative

The No Action Alternative would preserve the existing water quality regulatory environment and would not designate the project area an ORW. Impacts to air quality are difficult to ascertain because future construction in the project area is difficult to predict and subject to several interacting human variables, such as property values and other items discussed in Land Use (Section 4.4) and Socioeconomics (Section 4.5). Air quality impacts are likely to increase with increased human use of the area, including more vehicular traffic along the U.S. Highway 191 corridor, short-term carbon monoxide and particulate emissions from construction activities, and seasonally-increased particulate emissions from wood burning.

4.10.1.1 Primary Impacts

No primary impacts related to changes in air quality were identified as a result of the No Action Alternative. The increase in human use would be gradual and would not occur simultaneously with the policy decision to implement the No Action Alternative.

4.10.1.2 Secondary Impacts

Minimal secondary impacts related to changes in air quality were identified as a result of the No Action Alternative. Increase in human use and traffic associated with the potential build-out described in Section 4.4 would be gradual and are difficult to quantify. There may be a correspondingly gradual decrease in air quality as the level of development in the Gallatin Canyon, along the ORW, increases.

4.10.1.3 Cumulative Impacts

No cumulative impacts were identified as a result of the interaction of reasonably foreseeable actions in the study area and the adoption of the No Action Alternative.

4.10.1.4 Mitigation

Mitigating factors are not applicable to the No Action Alternative.

4.10.2 Proposed Action Alternative

The Proposed Action Alternative is to designate the project area an ORW. The mitigations presented in Sections 4.3 (Hydrology and Water Quality) and 4.4 (Land Use) demonstrate that the potential build-out could be similar under either alternative. Impacts to air quality due to the adoption of the Proposed Action Alternative would be similar to those described under the No Action Alternative.

4.10.2.1 Primary Impacts

No primary impacts related to changes in air quality were identified as a result of the Proposed Action Alternative. The increase in human use may be slower or less intensive than under the No Action Alternative, due to possibly slowed development. Any changes in air quality would be gradual and would not correspond with the policy decision to implement the Proposed Action

Alternative. Designating the project area an ORW may limit the development, and therefore less air pollution may result from fewer future construction activities. But, if mitigations were implemented, there would be virtually no difference in the two alternatives, in terms of development potential and subsequent impacts to air quality.

4.10.2.2 Secondary Impacts

Minimal secondary impacts related to changes in air quality were identified as a result of the Proposed Action Alternative. Increase in human use and traffic associated with the potential build-out described in Section 4.4 would be gradual. There may be a correspondingly gradual decrease in air quality under any alternative as the level of development in the Gallatin Canyon increases.

4.10.2.3 Cumulative Impacts

No cumulative impacts were identified as a result of the interaction of reasonably foreseeable actions in the study area and the adoption of the Proposed Action Alternative.

4.10.2.4 Mitigation

Mitigating factors are not applicable for this alternative.

4.10.3 Cumulative Impacts Analysis Alternative

The Cumulative Impacts Analysis Alternative would have DEQ using its discretionary ability to evaluate new developments cumulatively, along with previously approved developments and wastewater systems, to see if trigger values for phosphorus and nitrogen have been met. The mitigations presented in Sections 4.3 (Hydrology and Water Quality) and 4.4 (Land Use) demonstrate that the potential build-out could be similar under either alternative. Impacts to air quality due to the adoption of the Cumulative Impacts Analysis Alternative would thus be similar to those described under the No Action Alternative.

4.10.3.1 Primary Impacts

No primary impacts related to changes in air quality were identified as a result of the Cumulative Impacts Analysis Alternative. The increase in human use may be slower or less intensive than under the No Action Alternative, due to possibly slowed development. Any changes in air quality would be gradual and would not correspond with the policy decision to implement the Cumulative Impacts Analysis Alternative. Assessing development and wastewater applications cumulatively may limit development, and therefore less air pollution may result from less construction activity. But, if mitigations were implemented, there would be virtually no difference between the Cumulative Impacts Analysis Alternative and the No Action Alternative, in terms of development potential and subsequent impacts to air quality.

4.10.3.2 Secondary Impacts

Minimal secondary impacts related to changes in air quality were identified as a result of the Cumulative Impacts Analysis Alternative. Increase in human use and traffic associated with the potential build-out described in Section 4.4.3 would be gradual. There may be a correspondingly

gradual decrease in air quality under any alternative as the level of development in the Gallatin Canyon increases.

4.10.3.3 Cumulative Impacts

No cumulative impacts were identified as a result of the interaction of reasonably foreseeable actions in the study area and the adoption of the Cumulative Impacts Analysis Alternative.

4.10.3.4 Mitigation

Mitigating factors are not applicable for this alternative.

4.11 Cultural Resources

4.11.1 No Action Alternative

The No Action Alternative would pose limited impacts to known or unknown cultural resources. Since the No Action Alternative maintains status quo activities related to water quality regulation within the Gallatin River, such No Action efforts would have no immediate impact on prehistoric and historic period cultural resources in the area. Secondary impacts may occur as described below. Except for historic bridge abutments, no cultural resources are known to exist within the defined watercourse of the Gallatin River. Current and ongoing plans and efforts to enhance the water quality of the Gallatin River will pose no impacts to cultural resources of the area.

4.11.1.1 Primary Impacts

As described for other resources, the time delay inherent in the regulatory nature of the No Action Alternative would mean that no primary impacts to cultural resources are likely within the study area.

4.11.1.2 Secondary Impacts

The No Action Alternative may cause some secondary impacts to cultural resources within the study area due to ground disturbance during site development. Because the exact location and extent of actual future disturbances cannot be known with any real certainty, it is difficult to determine how many sites would be disturbed or potentially damaged. Another challenging aspect of this assessment is that the entire area has not been surveyed; therefore, the total number and distribution of sites is not known. Given the existing documentation, it is reasonable to assume that there would be some disturbance of cultural sites under the No Action Alternative.

4.11.1.3 Cumulative Impacts

The No Action Alternative may present some cumulative impacts to cultural resources within the study area when evaluated with other reasonably foreseeable actions such as the continued development within the Big Sky Water and Sewer District.

4.11.1.4 Mitigation

The activities that are likely to cause impacts to cultural resources involve surface disturbance, such as earth moving required for home building. Therefore, mitigation that would reduce potential negative impacts to cultural resources from the No Action Alternative would include:

- Comparing development sites to the SHPO maps of known or suspected cultural resource areas.
- Surveying areas slated for ground-disturbing activities for cultural resources prior to initiating site disturbance.
- Limiting the surface area disturbance to immediate development area and avoid clearing entire sites.

Cultural resource surveys would be the most effective way to reduce the likelihood of destruction of cultural sites. Gallatin County has adopted cultural resource inventory and evaluation requirements as a part of its subdivision review regulations (Gallatin County 2005a).

4.11.2 Proposed Action Alternative

The Proposed Action Alternative would most likely incur fewer impacts to known or unknown cultural resources. Since the Proposed Action Alternative focuses on maintaining current water quality within the Gallatin River, such efforts would have no primary impact on prehistoric and historic period cultural resources in the area. Except for historic bridge abutments, no cultural resources are known to exist within the defined water course of the Gallatin River. Maintaining the current water quality of the Gallatin River would pose no impacts to cultural resources of the area. The mitigations proposed in Sections 4.4 would allow levels of development similar to those permissible under the No Action Alternative; therefore, the actual impacts of the mitigated Proposed Action Alternative on cultural resources are virtually identical to those under the No Action Alternative.

4.11.2.1 Primary Impacts

As described for other resources, the time delay inherent in the regulatory nature of the Proposed Action Alternative would mean that no primary impacts to cultural resources are likely within the study area.

4.11.2.2 Secondary Impacts

If mitigations are adopted as described in Section 4.4, then the Proposed Action Alternative would present secondary impacts that are virtually identical to those under the No Action Alternative to cultural resources within the study area.

4.11.2.3 Cumulative Impacts

The Proposed Action Alternative would present cumulative impacts that are virtually identical to those under the No Action Alternative to cultural resources within the study area.

4.11.2.4 Mitigation

Due to the fact that the impacts to cultural resources due to adoption of the Proposed Action Alternative as mitigated in Section 4.4 are similar to those identified for the No Action Alternative; recommendations for mitigation would be the same as those described for the No Action Alternative.

4.11.3 Cumulative Impacts Analysis Alternative

This section presents impacts related to cultural resources in the study area described in Section 3.11. In general, the regulatory nature of the alternatives under consideration for the ORW designation limits impacts to cultural resources.

It is foreseen that, if chosen, the Cumulative Impacts Analysis Alternative will pose no impacts to known or unknown cultural resources. Since the Cumulative Impacts Analysis Alternative

focuses on water quality mitigation plans through development planning within the Gallatin River, such efforts will have no impact on prehistoric and historic period cultural resources in the area. No cultural resources are known to exist within the defined water course of the Gallatin River, except historic bridge abutments. Plans and efforts to enhance the water quality of the Gallatin River will create no impacts to cultural resources of the area.

4.11.3.1 Primary Impacts

The Cumulative Impacts Analysis Alternative will present no primary impacts to cultural resources within the study area.

4.11.3.2 Secondary Impacts

The Cumulative Impacts Analysis Alternative will present no secondary impacts to cultural resources within the study area.

4.11.3.3 Cumulative Impacts

The Cumulative Impacts Analysis Alternative will present no cumulative impacts to cultural resources within the study area.

4.11.3.4 Mitigation

Due to the fact that there are no foreseeable impacts to cultural resources, there are no recommendations for mitigation presented.

4.12 Aesthetics

The aesthetic value of the Gallatin River corridor was identified as a community priority during the scoping process (GANDA 2006). The visual character of the corridor is economically significant to the state and is an important attraction to area residents and tourists for fishing, hiking, boating, wildlife viewing, bird watching, and other recreational pursuits.

4.12.1 No Action Alternative

Under the No Action Alternative, DEQ would continue to manage the proposed ORW reach under the current set of regulations and policies as described in Chapter 2. The No Action Alternative assumes the river would continue to be protected by current water quality laws, including existing state and federal surface water quality standards and nondegradation policy.

4.12.1.1 Primary Impacts

There would be no primary impacts to visual resources under the No Action Alternative. Visual resources would not be affected by maintaining the proposed ORW reach under the current set of regulations and policies as described in Chapter 2. Although water quality would be allowed to degrade to the current B-1 standards (See Section 3.3) under this alternative, the visual resources of the corridor would not be affected.

4.12.1.2 Secondary Impacts

Without the more stringent protection offered by the Proposed Action, secondary impacts of the No Action Alternative would occur to the study area viewsheds. Approximately two-thirds of the land within the ORW reach is in public ownership. Aesthetic impacts from increased development would be primarily noticeable in commercial- and residentially-zoned areas. Future development within the footprint would continue to be regulated by setback requirements, and proposed actions would still require a water quality impacts review, if they include any discharge to ground or surface waters, such as a septic system. The density of development may impact the aesthetic quality of the corridor. The difference in allowable development would be due to lower water quality protection standards of the No Action Alternative, when compared with the more stringent protection under the Proposed Action Alternative, as described in Section 4.3.

4.12.1.3 Cumulative Impacts

Development within the privately held areas could continue to full build-out potential (Section 4.4) under the No Action Alternative. This future development could impair the aesthetic quality of the river corridor near the highway. This impairment would not affect the character of the entire corridor. Recent changes to required setbacks for buildings along water bodies have substantially reduced the likelihood that development will be clustered along the riparian corridor. The No Action Alternative would not change the appearance of the surrounding viewsheds, topography, or local flora and fauna.

4.12.1.4 Mitigation

Given that the No Action Alternative would result in minor impacts on visual resources, no mitigation measures are necessary.

4.12.2 Proposed Action Alternative

Under the Proposed Action Alternative, DEQ could not grant an authorization to degrade the section of the Gallatin River proposed for ORW status for any activity (75-5-316(2), MCA).

4.12.2.1 Primary Impacts

There would be no primary impacts on visual resources under the Proposed Action Alternative, as the ORW designation would change only the degree of protection for waters in the Gallatin River. The designation would not change the appearance of the surrounding viewsheds, topography, or local flora/fauna.

4.12.2.2 Secondary Impacts

With the more stringent protection offered by the Proposed Alternative, secondary impacts of the Proposed Action Alternative could occur but at a substantially reduced level from that predicted for the No Action Alternative. Most of the land within the ORW reach is in public ownership. Aesthetic impacts from reduced further development would be primarily noticeable in commercial- and residentially-zoned areas. Future development within the footprint would continue to be regulated by setback requirements, and proposed actions would still require a water quality impacts review, if they include any discharge to ground or surface waters, such as a septic system. Development would be allowed to continue, which may impact the aesthetic quality of the corridor. The difference in allowable development would be due to the more stringent water quality protection standards of the proposed ORW designation, when compared with existing conditions under the No Action Alternative, as described in Section 4.4.

4.12.2.3 Cumulative Impacts

Development within the privately held areas could continue to full build-out potential if alternative wastewater treatment systems are used (Table 4.3-1). Under the Proposed Action Alternative, future development could impair the aesthetic quality of the river corridor near the highway. However, ORW designation would not affect the visual character or appearance of the surrounding viewsheds, topography, or local flora/fauna.

4.12.2.4 Mitigation

Given that the Proposed Action Alternative would not result in any significant impacts on visual resources, no mitigation measures are necessary.

4.12.3 Cumulative Impacts Analysis Alternative

Under the Cumulative Impacts Analysis Alternative, DEQ could use its discretionary authority to assess cumulative impacts to water quality within the footprint. This alternative would allow DEQ to evaluate proposed developments using the narrative standard as provided under the No Action Alternative, but unlike the No Action Alternative, it would require cumulative impacts analysis of past and proposed unrelated developments in the analysis of the narrative standard.

4.12.3.1 Primary Impacts

There would be no primary impacts on visual resources under the Cumulative Impacts Analysis Alternative. Adoption of this alternative would not change the appearance of the surrounding viewsheds, topography, or local flora/fauna.

4.12.3.2 Secondary Impacts

Development would be allowed to continue, which may impact the aesthetic quality of the corridor. As described in previous sections, this alternative would have few limitations on development up to the 67 SFE benchmark. Development beyond this benchmark would require the use of advanced water treatment systems. Impacts would be primarily noticeable in commercial and residentially zoned areas. Future development within the footprint would continue to be regulated by setback requirements, and proposed actions would still require a water quality impacts review, if they include any discharge to ground or surface waters, such as septic systems.

Secondary impacts associated with this alternative could be accelerated by the “first come, first served” nature of management. If there is a rush to develop land quickly, impacts to the aesthetic resources would be more noticeable in the short term due to construction activities concentrated in a condensed time frame. These impacts would be most noticeable along the river and highway corridor, and would not change the appearance of the surrounding viewsheds, topography, or local flora/fauna.

4.12.3.3 Cumulative Impacts

Under the Cumulative Impacts Analysis Alternative, development within the privately held areas could continue to full build-out potential if alternative wastewater treatment systems were used (Table 4.3-1). Depending on the type of treatment system used, impacts to the aesthetic quality of the river corridor near the highway would be similar as under the Proposed Alternative with mitigation. However, the Cumulative Impacts Analysis Alternative would not affect the visual character or appearance of the surrounding viewsheds, topography, or local flora/fauna.

In contrast to the Proposed Alternative, there is no permanence to the Cumulative Impacts Analysis Alternative. The Gallatin River would not be protected in perpetuity, as the alternative involves a policy change, not a legislative designation to protect water quality. If the policies and/or numeric standards associated with this alternative are amended or revoked, impacts would be the same as those under the No Action Alternative.

4.12.3.4 Mitigation

Given that the Cumulative Impacts Analysis Alternative would not result in any significant impacts on visual resources, no mitigation measures are necessary.

4.13 Residual Impacts

Residual impacts include those that would persist after appropriate mitigations have been implemented. The impacts listed here are those that cannot be addressed or alleviated by modifications in the alternatives as proposed. These impacts are often associated with changes in the landscape or removal of resources from an area. Based on the resource specialists' reviews of the No Action, Proposed Action, and Cumulative Impacts Analysis alternatives there would be no residual impacts to the following resources due to adoption of any of the alternatives:

- Wildlife
- Cultural resources

4.13.1 No Action Alternative

4.13.1.1 Geology and Soils

Residual impacts for the No Action Alternative with respect to geology and soils may include all those typically associated with the recreational and commercial development that occurs at Big Sky, such as:

- Some degree of soil disturbance due to development along the Gallatin River corridor, including soil loss due to erosion,
- Covering of soils by development,
- Alteration of native soils by excavation and filling activities associated with roads, structures and recreational facilities, and
- Changes to soil characteristics resulting from changed land use and land cover.

4.13.1.2 Hydrology and Water Quality

Residual impacts for the No Action Alternative with respect to hydrology may include the following:

- Some degree of increased loading of nutrients and sediment to the Gallatin River from regulated and nonregulated development,
- Aggravated water quality conditions downstream of the Gallatin River Canyon (i.e. downstream of the ORW reach) as the increased pollutant loads combine with reduced river flows. Reduced river flows could occur due to growth within the Gallatin River watershed and depletion of groundwater by private wells.

The increased loading of nutrients in the Gallatin River from development is a residual impact since it is essentially assumed to be irreversible. The increased nutrient loading comes from SFEs and commercial buildings that have been developed, and once built, the assumption is that they will continue to contribute the same amount of phosphorus and nitrogen loading into the river in perpetuity.

4.13.1.3 Land Use and Recreation

- Loss of undeveloped ground would occur under this Alternative, however it will occur under any alternative and is not directly related to the Alternative.

4.13.1.4 Socioeconomics

Residual impacts for the No Action Alternative with respect to socioeconomics may include the following:

- The decrease in water quality would result in a slight reduction in passive use values for Montana residents, and hence a slight decrease in their perceived quality of life in Montana.

4.13.1.5 Fisheries and Aquatic Resources

Residual impacts for the No Action Alternative with respect to fisheries and aquatic resources may include the following:

- Some changes in the aquatic community due to increased loading of nutrients and sediment to the Gallatin River from regulated and nonregulated development.

4.13.1.6 Vegetation Resources

Residual impacts for the No Action Alternative with respect to vegetation may include the following:

- Removal of some vegetation due to development, which would occur under any alternative.
- Alterations to hydrology, that could impact annual Indian paintbrush, may be unavoidable under the No Action Alternative.

4.13.1.7 Air Quality

Residual impacts for the No Action Alternative with respect to air quality may include the following:

- Some degree of increased particulates due to increased human activity (including traffic) in the study area.

4.13.1.8 Aesthetics

Residual impacts for the No Action Alternative with respect to aesthetics may include the following:

- Some degree of increased development in the riparian corridor that would be visible from U.S. Highway 191 and the surrounding public lands.

4.13.2 Proposed Action Alternative

The mitigations described in Section 4.3 that reduce the nutrient loading from subsurface wastewater treatment systems would allow virtually identical levels of development under either alternative. However, adoption of these alternative wastewater treatment options would alleviate the residual impacts to water quality and aquatic resources due to nutrient loading.

4.13.2.1 Geology and Soils

Residual impacts for the Proposed Action Alternative with respect to geology and soils may include the following:

- Some degree of soil disturbance due to development along the Gallatin River corridor, including some soil loss due to erosion,
- Covering of soils by development,
- Alteration of native soils by excavation and filling activities associated with roads, structures and recreational facilities,
- Changes to soil characteristics resulting from changed land use and land cover, and
- As noted in previous sections, limiting development within the vulnerability footprint could shift some development to terrain less amenable to development. These areas tend to include terrain with steeper slopes or less stable soils. Such a shift could lead to more soil disturbance in steeper areas with higher erosion potential. Unless appropriate management practices were used, delivery of sediment to drainages that lead to the ORW could increase.

4.13.2.2 Hydrology

Residual impacts for the Proposed Action Alternative with respect to hydrology may include the following:

- A small degree of increased loading of nutrients and sediment to the Gallatin River from nonregulated development.

4.13.2.3 Land Use and Recreation

Because there are available technologically feasible mitigations to reduce or nullify the adverse impacts of the Proposed Action Alternative on land use and recreation (Table 4.3-1), there would be no residual impacts. The decision of involved landowners to use one or a combination of the alternative wastewater management options described under Mitigation above would likely be based on economic feasibility (see Section 4.5, Socioeconomics).

4.13.2.4 Socioeconomics

No residual impacts are anticipated.

4.13.2.5 Fisheries and Aquatic Resources

No residual impacts are anticipated.

4.13.2.6 Vegetation Resources

Residual impacts for the Proposed Action Alternative with respect to vegetation may include the following:

- Removal of some vegetation due to development, which would occur under any alternative.
- Alterations to hydrology, that could impact annual Indian paintbrush, may also be unavoidable under the Proposed Action Alternative.

4.13.2.7 Air Quality

Residual impacts for the Proposed Action Alternative with respect to air quality may include the following:

- Some degree of increased particulates due to increased human activity (including traffic) in the study area.

4.13.2.8 Aesthetics

Residual impacts for the Proposed Action Alternative with respect to visual resources may include the following:

- Some degree of increased development in the riparian corridor that will be visible from U.S. Highway 191 and the surrounding public lands.

4.13.3 Cumulative Impacts Analysis Alternative

The mitigations described in Section 4.3 that reduce the nutrient loading from subsurface wastewater treatment systems would allow virtually identical levels of development under either alternative. However, adoption of these alternative wastewater treatment options would alleviate the residual impacts to water quality and aquatic resources due to nutrient loading.

4.13.3.1 Geology and Soils

Residual impacts for the Proposed Action Alternative with respect to geology and soils may include the following:

- Some degree of soil disturbance due to development along the Gallatin River corridor, including some soil loss due to erosion,
- Covering of soils by development,
- Alteration of native soils by excavation and filling activities associated with roads, structures and recreational facilities, and
- Changes to soil characteristics resulting from changed land use and land cover.
- As noted in previous sections, limiting development within the vulnerability footprint could shift some development to terrain less amenable to development. These areas tend to include terrain with steeper slopes or less stable soils. Such a shift could lead to more soil

disturbance in steeper areas with higher erosion potential. Unless appropriate management practices were used, delivery of sediment to drainages that lead to the ORW could increase.

4.13.3.2 Hydrology

Residual impacts for the Proposed Action Alternative with respect to hydrology may include the following:

- A small degree of increased loading of nutrients and sediment to the Gallatin River from nonregulated development,

4.13.3.3 Land Use and Recreation

Because there are available technologically feasible mitigations to reduce or nullify the adverse impacts of the Proposed Action Alternative on land use and recreation (Table 4.3-1), there would be no residual impacts. The decision of involved landowners to use one or a combination of the alternative wastewater management options described under Mitigation above would likely be based on economic feasibility (see Section 4.5, Socioeconomics).

4.13.3.4 Socioeconomics

No residual impacts are anticipated.

4.13.3.5 Fisheries and Aquatic Resources

No residual impacts are anticipated.

4.13.3.6 Vegetation Resources

Residual impacts for the Proposed Action Alternative with respect to vegetation may include the following:

- Removal of some vegetation due to development, which would occur under any alternative.
- Alterations to hydrology, that could impact annual Indian paintbrush, may also be unavoidable under the Proposed Action Alternative.

4.13.3.7 Air Quality

Residual impacts for the Proposed Action Alternative with respect to air quality may include the following:

- Some degree of increased particulates due to increased human activity (including traffic) in the study area.

4.13.3.8 Aesthetics

Residual impacts for the Proposed Action Alternative with respect to visual resources may include the following:

- Some degree of increased development in the riparian corridor that will be visible from U.S. Highway 191 and the surrounding public lands.

4.14 Regulatory Restrictions Analysis

The area that is hydrologically connected to the proposed ORW reach of the Gallatin River contains about 18,500 acres. Of this acreage, privately owned land that is undeveloped or partially developed covers 1,846 acres. Full build-out of this private land under current zoning regulations could add 652 dwelling units and 419,000 square feet of commercial development to the study area (Tables 4.4-3 and 4.4-4). If conventional subsurface wastewater treatment systems were used, a measurable change in water quality in the ORW reach from phosphorus and nitrogen loading would occur before full build-out was achieved.

To comply with the ORW designation requirement of no measurable change in water quality, approximately 67 SFEs and 2,645 square feet of commercial development could be added to the study area (Table 4.4-5). This restriction would represent a reduction of 89% SFEs and more than 99% of the square feet in commercial development.

Several alternatives to subsurface wastewater treatment systems, with varying effectiveness in controlling nutrients, are available that could increase the available amount of build-out under the Proposed Action (Table 4.3-1). Re-circulating sand filters would allow 105 dwelling units and 3,777 square feet of commercial development. Chemical removal would allow 148 dwelling units and 5,287 square feet of commercial development. Composting or incinerator toilets would allow 200 dwelling units and 7,145 square feet of commercial development. Zero discharge and centralized treatment would allow full build-out (Tables 4.4-6 and 4.4-7).

The cost of alternative treatment systems varies with the system. Composting toilets would add about $3,200 to the cost of a single-family dwelling unit. Re-circulating sand filters would add as much as $22,000 to the cost of a single-family dwelling unit. Maintenance costs would add to these amounts (Table 4.3-1).

The median price of an existing house in the Big Sky area is almost $250,000. Adding the cost of composting toilets would increase this price on average by about 1.5%. A high-end re-circulating sand filter system would add about 9% on average to the price of the house. For a new house plus the lot, these percentages would be smaller (Section 4.5.2.4).

Studies of water quality effects on property values suggest that clean water can add 3% to 20% (average 6%) to the value of a house (Section 3.5.3.8). Protecting the quality of the Gallatin River could increase the value of future property development enough to compensate for the added cost of alternative wastewater treatment systems.

Chapter 5 Consultation and Coordination

5.1 Hydrology, Geology and Soils:

Contact Name	Title	Agency	Date of Contact
Shane Bofto			
Katie Alvin	Director	Blue Water Task Force	January12, 2006 left message
Steve Carson	GIS Analyst	Montana Fish, Wildlife and Parks	January12, 2006
Eric Regensburger	Hydrogeologist	Montana Department of Environmental Quality	January13 and 20, 2006
Mel White	Hydrologist	USGS-Helena	January13, 2006
Peter McCarthy	Hydrologist	USGS-Helena	January13, 2006
Ron Edwards	General Manager	Big Sky Sewer and Water District	January13, 2006
Greg Hallsten Eric Regensburger	EIS Coordinator Hydrogeologist	Montana Department of Environmental Quality (Conference Call, with Leanne Roulson)	January19, 2006
Art Compton Greg Hallsten. Eric Regensburger	Section Supervisor EIS Coordinator Hydrogeologist	Montana Department of Environmental Quality (Meeting in Helena, with Leanne Roulson)	February 1, 2006
Tom Osborne			
Art Compton Eric Regensburger	Section Supervisor Hydrogeologist	Montana Department of Environmental Quality (Meeting in Helena, with Leanne Roulson)	November 30, 2005
Dr. William Woessner	Geology Dept	University of Montana	December 14, 2005
Eric Regensburger	Hydrogeologist	Montana Department of Environmental Quality	January 9, 2006 February 7, 2006
Joe Meek	Section Supervisor Source Water Protection Program	Montana Department of Environmental Quality	January 9, 2006
Steve Custer	Professor	Montana State University	February 9, 2006
Kristen Gardner	PhD Student	Montana State University	February10, 2006

5.2 Land Use and Recreation:

Contact Name	Title	Agency	Date of Contact
Paul Bussi	Planner	Gallatin County	January 23, 2006 February 23, 2006 March 10, 2006
Steve Christiansen	Environmental Coordinator, Planning Branch	Gallatin National Forest	January 25, 2006
Tom Keyes	Zone Environmental Engineer	Gallatin National Forest, Bozeman Ranger District	March 21, 2006
Fred King	Wildlife Area Manager	Montana Fish, Wildlife and Parks	February 6, 2006 March 21, 2006 March 28, 2006
Steve Martell	Forestry Technician	Gallatin National Forest,	February 6, 2006

Contact Name	Title	Agency	Date of Contact
		Bozeman Ranger District	
Russ Miller		Turner Enterprises	March 21, 2006
Jane Ruchman	Landscape Architect	Gallatin National Forest	February 6, 2006
Teri Seth	NEPA Specialist-Fire	Gallatin National Forest	February 6, 2006 February 7, 2006
Mark Story	Hydrologist	Gallatin National Forest	January 25, 2006
Peter Werner	Mining Engineer	Gallatin National Forest	February 7, 2006
Charlie Sperry	Recreation Management Specialist	Montana Fish, Wildlife and Parks	February 6, 2006

5.3 Socioeconomics:

Contact Name	Title	Agency	Date of Contact
Jeff Blend	Economist	Montana Department of Environmental Quality	December 12, 2005
Rob Brooks	Economist	Montana Fish, Wildlife and Parks	December 29, 2005
Jeff Blend, Art Compton, Eric Regensburger	Economist, Hydrologists	Montana Department of Environmental Quality	January 19, 2006
Paul Bussi	Planner	Gallatin County	January 23, 2005
Ron Edwards	Manager	Big Sky Water and Sewer	January 24, 2006
Jeff Blend	Economist	Montana Department of Environmental Quality	March 9, 2006

5.4 Aquatics and Fisheries:

Contact Name Leanne Roulson	Title	Agency	Date of Contact
Katie Alvin	Director	Blue Water Task Force	January 13, 24, 2006
Joel Tohtz	Fisheries Biologist	Montana Fish, Wildlife and Parks	December 20, 28, 2005, March 30, 2006
Don Skaar	Pollution Control Biologist	Montana Fish, Wildlife and Parks	December 12, 2005, February 12, 2006
Jim Magee	Arctic Grayling Coordinator	Montana Fish, Wildlife and Parks	February 22, 2006
Brad Shepard	Fisheries Biologist	Montana Fish, Wildlife and Parks	February 15, 2006
Patrick Byorth	Fisheries Biologist	Montana Fish, Wildlife and Parks	February 14, 2006
Scott Barndt	Fisheries Biologist	Gallatin National Forest	
Bruce Roberts	West Zone Fisheries Biologist	Gallatin National Forest	February 16, 2006
Mark Story		Gallatin National Forest	January 26 and February 8, 2006
Kathy Lloyd	Database Manager	Montanan Natural Heritage Program	January 9, 2006
Eric Regensburger	Hydrogeologist	Montana Department of Environmental Quality	January 13, 24, 2006

Contact Name Leanne Roulson	Title	Agency	Date of Contact
Peter Schade	Senior TMDL Planner	Montana Department of Environmental Quality	January 18, 24, 2006
Greg Hallsten Eric Regensburger	EIS Coordinator Hydrogeologist	Montana Department of Environmental Quality (Conference Call, with HydroSolutions)	January19, 2006
Art Compton Greg Hallsten. Eric Regensburger	Section Supervisor EIS Coordinator Hydrogeologist	Montana Department of Environmental Quality (Meeting in Helena)	FebruaryJanuary06

5.5 Vegetation:

Contact Name	Title	Agency	Date of Contact
Reggie Clark	Range Conservationist	Gallatin National Forest, Bozeman Ranger District	January 13, 16, 20 and 23, 2006
John Councilman	Resource Assistant	Gallatin National Forest, Bozeman Ranger District	January 23, 2006
Susan Lamont	Forester	Gallatin National Forest, Hebgen Lake Ranger District	January 13, 16, 26 and 27, 2006
Dennis Hengel	Weed Coordinator	Gallatin County Weed District	January 13 and 20, 2006
Joshua Kellar	Coordinator	Northern Rocky Mountain Resource Conservation and Development	January 20, 2006
Phil Johnson	Botanist	Montana Department of Transportation	January 24, 2006
Tom Reid	Permits Program Supervisor	Water Protection Bureau, Montana Department of Environmental Quality	January 31, 2006
Banning Starr	Water Quality Specialist	Water Protection Bureau, Montana Department of Environmental Quality	January 31 and February 1, 2006

5.6 Wildlife:

Contact Name	Title	Agency	Date of Contact
Bev Dixon	Wildlife Biologist	Gallatin National Forest, Bozeman Ranger District	February 8 and 28, 2006
Craig Jourdonnais	Wildlife Biologist	Montana Fish, Wildlife and Parks	February 17, 2006
Dan Brewer	Fisheries Biologist/project contact	US Fish and Wildlife Service, Helena MT	March 6 and May 11 2006
R. Mark Wilson	Field Supervisor	US Fish and Wildlife Service, Helena MT	February 24, 2006
Kurt Alt	Wildlife Biologist	Montana Fish, Wildlife and Parks	February 6, 2006

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Clint Sestrich	Fisheries Biologist	Gallatin National Forest, Hebgen Ranger District	February 27, 2006

5.7 Air Quality:

Contact Name	Title	Agency	Date of Contact
Elton Erp	Air Monitoring Supervisor	Montana Department of Environmental Quality	Jan. 24, 2006

5.8 Cultural Resources:

Contact Name	Title	Agency	Date of Contact
Walt Allen	Forest Archaeologist	Gallatin National Forest, Supervisor's Office, Bozeman	January1January06
Tom Ballard	Archaeological Tech	Gallatin National Forest, Supervisor's Office, Bozeman	January17, 2006
Damon Murdo	Cultural Records Manager	State Historic Preservation Office, Helena	January19, 2006, February23, 2006
Dr. Mark Baumler	State Historic Preservation Officer, Acting Dir. Montana Historical Society	State Historic Preservation Office, Helena	February23, 2006

Chapter 6 List of Preparers

Preparer	Area of Expertise	Education
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		B.S. with Honors, Biology, emphasis in Botanical Sciences and minor in Wildlife Biology, University of Montana
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Chapter 7 Response to Public Comments

To be completed in Final EIS after public comment period

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Appendices

Appendix A:

Nutrient Surface Water Loading Calculations for the Gallatin River Outstanding Resource Water EIS

APPENDIX A: NUTRIENT SURFACE WATER LOADING – GALLATIN ORW

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DATE: JULY 18, 2006

Introduction

The purpose of this technical memorandum is to present a preliminary evaluation of nutrient loading on the Gallatin River mainstem from subsurface wastewater treatment systems (SWTSs) with regards to the DEQ Circular, DEQ-7 (2005) with a nitrate (as N) trigger value of 0.01 mg/L and a phosphorus (as P) trigger value of 0.001 mg/L. For nondegradation analysis, the trigger value is considered the allowable increase above the background value in surface water, and is also considered the threshold for measurable change when considering the Outstanding Resource Water.

Gallatin River Flow Estimates

Flow data for the Gallatin River was obtained from the USGS Statistical Summaries of Streamflow for the Gallatin River near Gallatin Gateway, Montana (USGS Gauging Station 06043500). A 7Q10 (7 day consecutive 10 year low flow) value was reported at 204 cubic feet per second (CFS). A 7Q10 value of 138 CFS was used for the Gallatin River mainstem above the West Fork confluence with the Gallatin River. This value was obtained through the DEQ and Big Sky Water and Sewer District MPDES permit and based on drainage area ratios. The 7Q10 value represents a consistent low flow value used for conservative dilution calculations for constituent loading in this particular stretch of the river system.

Subsurface Wastewater Treatment Systems Basis

SWTS were evaluated as Single Family Entities (SFEs), a unit which corresponds to a single-family home that produces nitrate concentration which varies with treatment type, but has a DEQ default value of 50 mg/L as N and phosphorus concentration of 10.6 mg/L as P. The DEQ default flow rate of 200 gallons per day (gpd) is used for each SFE. Based on the Nicklin Earth & Water, Inc. memo to the DEQ dated April 18, 2000, the Yellowstone Mountain Club and Spanish Peaks nondegradation analysis had a projected average effluent flow of 153 gpd per SFE. This value was determined to be appropriate for use in the Gallatin ORW project since the nature of expected residential and second home development would be similar.

Using the *Dilution Equation* found in Appendix P (below) of Adjacent to Surface Water Dilution Analysis, found in the *How To Perform A Nondegradation Analysis for SWTS* by the DEQ (http://deq.mt.gov/wqinfo/Nondeg/HowToNonDeReg.asp), values were calculated for each of the above referenced conditions to obtain a maximum number of SFEs to reach the in-stream nitrate and phosphorus trigger values.

This method is used to quantify potential loading of constituents from SWTS adjacent to high quality state surface waters in accordance with ARM 17.36.312. The method does not account for any nitrate or phosphorus attenuation and/or dilution in ground water and assumes a direct hydrogeologic connection to the surface water with 100 percent of the SWTS load reaching the surface water. Therefore, this method represents a conservative approach for estimating nutrient loading.

Calculation Example

The following example demonstrates how we used the dilution equation to calculate the total loading for nitrate in the proposed ORW reach of the Gallatin River.

Beginning with the full equation:

$$\frac{(Q_D)\times(C_D) + (Q_L)\times(C_L)}{Q_D + Q_L} < \textbf{Trigger Value} = \text{nonsignificant}$$

Parameter definitions and applicable values:

Q_D = Effluent flow rate from drainfield (200 gpd per single-family home between 2 and 5 bedrooms or 153 gpd for Big Sky equivalent)
C_D= Nitrate concentration (50 mg/L for conventional or 24 mg/L for Level 2) or phosphorus concentration (10.6 mg/L) in effluent
Q_L= Flow rate into (or out of) surface water determined by stream gauge (usually the 7-day, 10-year low flow; 7Q10)
C_L = Nitrate or phosphorus concentration in surface water (can typically assume zero since increase, not total, is important)

Conversions
1 lb/yr = 0.0144 mg/sec
1 cfs=28.3 L/s

Because C_L is equal to zero, the second term in the numerator drops out (any number times zero is zero). Therefore, the equation simplifies to:

$$\frac{(Q_D)\times(C_D)}{Q_D + Q_L} < \textbf{Trigger Value} = \text{non-significant}$$

Q_D is so small (less than 0.08% of the 7Q10 at 700, or any number less SFEs) when compared with Q_L that it is negligible; therefore:

$$\frac{(Q_D)\times(C_D)}{Q_L} < \textbf{Trigger Value} = \text{non-significant}$$

Since the numerator represents the total loading, and is our parameter of interest, we set it equal to X and solve for that number.

$$\frac{(Q_D)\times(C_D)}{Q_L} < \textbf{Trigger Value} = 0.01 \text{ mg/L (for Nitrogen)}$$

Or, the equation rearranged to solve for X yields:

$$\textbf{(Trigger value)}\times(Q_L) = (Q_D)\text{x}(C_D) = X$$

$$\textbf{(Trigger value)}\times(Q_L) = X$$

The concentration, or trigger value, times the flow, or Q_L, yields a load in milligrams per second (when all units are standardized to the metric).

First we need to convert the flow in cfs to L/s:

Q_L=204 cfs (7Q10 value at Gallatin Gateway) ×28.3l257 L/s per cfs = 5,776.6 l/s

Then, by rearranging the equation, the total loading at Gallatin Gateway for Nitrate is:

(Trigger value)×(Q_L) =(Q_D)x(C_D)=X

(0.01mg/L) × (5,776.6 L/s) = **(Q_D)(C_D)=X=**57.776 mg/s

Which converts to lbs/year **(**1 lb/yr = 0.0144 mg/sec) = 57.776/0.0144 = 4,007.8 [1] lbs/year

(Q_D)×(C_D) = X

Since the Q_D and C_D are known constants associated with the nutrient load generated by one SFE, we can then divide this load by the number of pounds of nutrient generated annually by one SFE to get the total number of SFEs that would meet the total load we just calculated.

Nitrate Loading Evaluation

A typical SWTS produces 23.33 lbs/year Nitrate (50 mg/L at 153 gpd)

Substitution:
1 SFE yields 23.33 lbs N/year

$$\frac{4{,}007.8 \text{ lbs/year}}{23.33 \text{ lbs N/year}} = 172 \text{ SFE at Gallatin Gateway}$$

SWST background data included a nitrate loading default value as well as approved values for Levels 2, 1a and 1b type SWTS (http://deq.mt.gov/wqinfo/Nondeg/level2_web_list.pdf) with level 2 having the highest level of nitrate treatment (lowest nitrate output) and level 1b having the lowest treatment (highest nitrate output). The DEQ uses a default value of 50 mg/L nitrate as N, when the treatment system is not designed to remove nitrogen. At a 200 gpd flow with a nitrate concentration of 50 mg/L, the resultant nitrate loading as N would be 30.5 lbs/yr, and 23.33 lbs/yr at 153 gpd.

Table A-1 summarizes the maximum number of SFEs allowable which still meet the nitrate trigger value at the two flow points on the mainstem (Gallatin River near Gallatin Gateway and above the West Fork confluence) at two different SFE flow rates for each septic system type. The first rate represents the estimated flow for the Gallatin area while the second flow is the DEQ default value for SWTSs. SFEs were used in the analysis to generally quantify the number of single family entities based on projected loading. The number of SFEs was not intended to be used as a regulatory unit.

[1] In the original calculations and conversions, we did not round any parameters. The final answers were rounded to the appropriate significant figures.

Table A-1. SFE Evaluation for Nitrate Surface Water Loading

System Type	Nitrate Effluent Value (mg/L as N)	Max. No. of SFE at 153 gal/day: No. of SFE on the Gallatin River at Gallatin Gateway	Max. No. of SFE at 153 gal/day: No. of SFE on the Gallatin River above West Fork	Max No. of SFE at 200 gal/day: No. of SFE on the Gallatin River at Gallatin Gateway	Max No. of SFE at 200 gal/day: No. of SFE on the Gallatin River above West Fork
Level 2	24	358	242	275	186
Level 1a	30	287	193	220	148
Level 1b	40	215	145	165	111
Default	50	172	116	132	89

Note: 7Q10 data for Gallatin River near Gallatin Gateway and above the confluence with the West Fork, were 204 and 138 cfs, respectively.

Phosphorus Loading Evaluation

The following shows how our results were calculated by substituting the values below into the dilution equation:

Picking up our example from the Nitrate calculations (above), and by rearranging the equation, the total loading at Gallatin Gateway for Phosphorus is:

(Trigger value)×(Q_L) =(Q_D)x(C_D)=X

(0.001mg/L) × (5,776.6 L/s) = **(Q_D)(C_D)=X=**5.7776 mg/s

Which converts to lbs/year **(**1 lb/yr = 0.0144 mg/sec) = 5.7776/0.0144 = 400.78 [2] lbs/year

(Q_D)×(C_D) = X

Since the Q_D and C_D are known constants associated with the nutrient load generated by one SFE, we can then divide this load by the number of pounds of nutrient generated annually by one SFE to get the total number of SFEs that would meet the total load we just calculated.

Substitution:
A typical SWTS produces 4.93 lbs/year Phosphorus (10.6 mg/L at 153 gpd)

Substitution:
1 SFE yields 4.93 lbs P/year

$$\frac{400.78 \text{ lbs/year}}{4.93 \text{ lbs P/year/ SFE}} = 81 \text{ SFE at Gallatin Gateway} - 14 \text{ SFE allocated for conservation easements and development of state lands} = 67 \text{ SFE}$$

SWTS background data from the DEQ nondegradation guidance document included a phosphorus loading default value of 6.44 lbs/yr. This value was based on a 200 gpd effluent flow with a phosphorus concentration of 10.6 mg/L. Adjusting the default loading value for the estimated 153 gpd effluent load calculated for the area, the phosphorus loading value becomes 4.93 lbs/yr. Currently, there are no SWTSs

[2] In the original calculations and conversions, we did not round any parameters. The final answers were rounded to the appropriate significant figures.

approved by DEQ that account for the treatment of phosphorus, and DEQ approval would be required before implementation of a phosphorus treatment system with discharge.

Again, using the *Dilution Equation* outlined in the previous section, the maximum number of SFEs was calculated at each of the phosphorus loading values at their corresponding SWTS effluent flows. As with the nitrate evaluation, it is assumed that 100 percent of the load from the SWTS reaches the surface water with no attenuation or dilution in the groundwater.

Table A- 2 summarizes the maximum number of SFEs to meet the phosphorus trigger value at the two flow points on the mainstem river (Gallatin River near Gallatin Gateway and above the West Fork confluence) at two different SFE flow rates for the SWTSs. Several phosphorus removal treatment efficiencies were used to predict the number of SFEs to meet the trigger value, although currently there are no DEQ approved SWTSs that reduce phosphorus. The treatment efficiencies were estimated based on long-term treatment efficiency and not those treatment efficiencies seen initially. The treatment efficiencies were taken from the Appendix G regarding Treatment System Evaluation, Gallatin ORW. Prior to implementation of any phosphorus treatment associated with SWTSs, DEQ must approve the particular system. SFEs were used in the analysis to generally quantify the number of single family entities based on projected loading. The number of SFEs was not intended to be used as a regulatory limit.

Table A-2. SFE Evaluation for Phosphorus Surface Water Loading

		Max. No. of SFE at 153 gal/day		Max No. of SFE at 200 gal/day	
SWTS Type and Estimated Treatment Efficiency[a]	**Phosphorus Effluent Value (mg/L as P)**	**No. of SFE on the Gallatin River at Gallatin Gateway**	**No. of SFE on the Gallatin River above West Fork**	**No. of SFE on the Gallatin River at Gallatin Gateway**	**No. of SFE on the Gallatin River above West Fork**
Typical	10.6	81	54	62	42
30% Treatment Recirc. Sand Filter	7.4	105	71	80	54
50% Treatment Chemical Removal	5.3	122	83	93	63

Note: a - Efficiencies were estimated based on HSI Technical Memorandum, Treatment System Evaluation, Gallatin ORW Project, February 20, 2006.
7Q10 data for Gallatin River near Gallatin Gateway and above the West Fork confluence, were 204 and 138 cfs, respectively.

Discussion

Based on the nutrient loading presented above, it appears that phosphorus is the limiting factor for nutrient loading. To meet the respective trigger values the number of SFEs for phosphorus is approximately half that of the SFEs for nitrate loading for typical treatment systems. The approach assumes 100% of the phosphorus or nitrate reaches the receiving water, and does not account for attenuation through mechanisms such as adsorption and plant photosynthesis.

Using the trigger value for phosphorus of 0.001 mg/L and the calculated 7Q10 on the Gallatin River at Gallatin Gateway of 204 cfs, a maximum loading for the end of the designated area of the Gallatin River ORW to meet the trigger value would be 400.78 lbs/year of phosphorus as P. This calculation results in a phosphorus loading of 1.96 lbs/yr/cfs of the Gallatin River near the end of the ORW at the 7Q10 value.

In a similar fashion using the trigger value for nitrate of 0.01 mg/L as N and the 7Q10 value, the maximum loading of nitrate would be 4,007.80 lbs/year as N, resulting in 19.65 lbs nitrate as N per cfs of the Gallatin River.

Based on the footprint analysis overlaid on the undeveloped acreage based on land use, there are approximately 1,846 acres of undeveloped land within the footprint (See Section 3.4). Allocating the pounds of phosphorus and nitrate over that acreage, there is 0.22 lbs P/acre and 2.17 lbs nitrate as N/acre. Using SFE of 4.93 lbs P/SFE and 23.33 lbs nitrate-N/SFE, allocation results are 22.69 undeveloped acres/SFE for phosphorus and 10.75 undeveloped acres/SFE for nitrate as N. Refer to Table A- 3, Maximum Nutrient Loading at 7Q10 at Gallatin River near Gallatin Gateway

Table A-3. Maximum Nutrient Loading at 7Q10 at Gallatin River near Gallatin Gateway

Parameter	Trigger Value mg/L	7Q10 Low Flow Gallatin River near Gallatin Gateway, cfs	Lbs to Meet Trigger Value	Lbs/cfs at Gallatin Gateway Near Gallatin Gateway	Lbs/Undeveloped Acre in Vulnerability Footprint	Minimum acreage for one SFE (standard wastewater treatment)
Phosphorous	0.001	204	400.78	1.96	0.22	22.69
Nitrate as N	0.01	204	4007.80	19.65	2.17	10.75

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Values used as basis for analyses:

Parameter	Value	Units	Source
Outflow	153	gpd	Nicklin Study (2000)
P per SWTS	10.6	mg/L	DEQ
	4.93	lbs/yr/SFE	DEQ (at 153 gpd)
	6.44	lbs/yr/SFE	DEQ (at 200 gpd)
N per SWTS	50	mg/L	DEQ
	23.33	lbs/yr/SFE	DEQ (at 153 gpd)
	30.50	lbs/yr/SFE	DEQ (at 200 gpd)
7Q10	204	cfs	McCarthy

Parameter	Value	Units	Source
Mean Feb Flow	299	cfs	Graph of means from McCarthy Summary
Trigger Values			
Phosphorus	0.001	mg/L	DEQ-7
Nitrogen	0.01	mg/L	DEQ-7
Maximum SFE available for development by area			
Max develop.	652	SFE	Per land use and socio-economics analysis (Chapter 3)
Max develop.	1846	Ac	Per land use and socio-economics analysis (Chapter 3)

Appendix B:

Plant Species Referenced in the Gallatin River Outstanding Resource Water Designation EIS

Appendix B: Plant species referenced in the Gallatin River Outstanding Resource Water Designation EIS

Lifeform	**Common Name**	**Latin Name**
tree	aspen	*Populus tremuloides*
tree	cottonwood	*Populus angustifolia*
tree	Douglas-fir	*Pseudotsuga menziesii*
tree	Engelmann Spruce	*Picea engelmannii*
tree	lodgepole pine	*Pinus contorta*
tree	subalpine fir	*Abies lasiocarpa*
tree	whitebark pine	*Pinus albicaulis*
shrub	alder	*Alnus* spp
shrub	birch	*Betula* spp.
shrub	black hawthorn	*Crataegus douglasii*
shrub	bog birch	*Betula glandulosa*
shrub	current	*Ribes* spp.
shrub	grouse whortleberry	*Vaccinium scoparium*
shrub	huckleberry	*Vaccinium spp.*
shrub	ninebark	*Physocarpus malvaceus*
shrub	mountain heath	*Phyllodoce glanduliflora*
shrub	menziesia	*Menziesia ferruginea*
shrub	Oregon grape	*Mahonia repens*
shrub	red-osier dogwood	*Cornus stolonifera*
shrub	rose	*Rosa* spp.
shrub	sagebrush	*Artemisia* spp.
shrub	serviceberry	*Amelanchier alnifolia*
shrub	shrubby cinquefoil	*Dasiphora floribunda*
shrub	snowberry	*Symphoricarpos* spp.
shrub	spirea	*Spiraea betulifolia*
shrub	willow	*Salix* spp.
graminoid	Baltic rush	*Juncus balticus*
graminoid	bluebunch wheatgrass	*Pseudoroegneria spicata*
graminoid	carex species	*Carex* spp.
graminoid	elk sedge	*Carex geyeri*
graminoid	green needlegrass	*Nassella viridula*
graminoid	hairgrass	*Deschampsia* spp.
graminoid	Idaho fescue	*Festuca idahoensis*
graminoid	needle & thread	*Hesperostipa comata*
graminoid	pinegrass	*Calamagrostis rubescens*
graminoid	reedgrass	*Calamagrostis* spp.
graminoid	smooth woodrush	*Luzula hitchcockii*
graminoid	timothy	*Phleum pretense*
forb	annual indian paintbrush	*Castilleja exilis*
forb	arnica	*Arnica* spp.
forb	arrowleaf balsamroot	*Balsamorhiza sagittata*
forb	beargrass	*Xerophyllum tenax*
forb	Canada thistle	*Cirsium arvense*
forb	cinquefoil	*Potentilla* spp.

Lifeform	**Common Name**	**Latin Name**
forb	common tansy	*Tanacetum vulgare*
forb	Dalmatian toadflax	*Linaria dalmatica*
forb	discoid goldenweed	*Haplopappus macronema var. macronema*
forb	English sundew	*Drosera anglica*
forb	Hall's rush	*Juncus hallii*
forb	houndstongue	*Cynoglossum officinale*
forb	large-leafed balsamroot	*Balsamorhiza macrophylla*
forb	leafy spurge	*Euphorbia esula*
forb	lupine	*Lupinus* spp.
forb	musk thistle	*Carduus nutans*
forb	orange hawkweed	*Hieracium aurantiacum*
forb	oxeye daisy	*Chrysanthemum leucanthemum*
forb	poison hemlock	*Conium maculatum*
forb	St. Johnswort	*Hypericum perforatum*
forb	small-winged sedge	*Carex stenoptila*
forb	spotted knapweed	*Centaurea maculosa*
forb	sulfur cinquefoil	*Potentilla recta*
forb	yellow toadflax	*Linaria vulgaris*

Appendix C: Location of Cultural Resource Study Area

Appendix C: Sections included in Cultural Resources file search

The study area for reviewing previously recorded cultural resource sites included the following sections. Existing site file records, reports, and maps on file at the Montana SHPO and USFS Gallatin National Forest were reviewed and summarized.

Cultural resources study area:

T4S R3E
Sect. 13

T4S R4E
Sect. 17, 18, 19, 20, 21, 27, 28, 29, 30, 32, 33, 34, 35, 36

T5S R4E
Sect. 3, 4, 5, 8, 9, 10, 14, 15, 16, 22, 23, 24, 25, 26, 35, 36

T5S R5E
Sect. 30, 31

T6S R3E
Sect. 25, 26, 27, 34, 35, 36

T6S R4E
Sect. 1, 2, 11, 12, 13, 14, 15, 21, 22, 23, 26, 27, 28, 29, 30, 31, 32, 33, 34

T6S R5E
Sect. 6, 7, 18

T7S R3E
Sect. 1, 2, 3

T7S R4E
Sect. 3, 4, 5, 6, 8, 9, 10, 15, 16, 17, 20, 21, 22, 27, 28, 29, 32, 33, 34

T8S R4E
Sect. 3, 4, 5, 8, 9, 10, 15, 16, 17, 20, 21, 22, 23, 26, 27, 28, 33, 34, 35

T9S R4E
Sect. 1, 2, 3, 10, 11, 12, 13

T9S R 5E
Sect. 6, 7, 8, 18, 19

Appendix D:

Documentation and File Search Summary Reports from Montana SHPO

MONTANA HISTORICAL SOCIETY
STATE HISTORIC PRESERVATION OFFICE

January 19, 2006

Scott Carpenter
GANDA
PO Box 160039
Big Sky MT 59716

RE: GALLATIN RIVER PLAN EIS. SHPO Project #: 2006011904

Dear Mr. Carpenter:

I have conducted a cultural resource file search for the above-cited project. According to our records there have been a few previously recorded sites within the designated search locales. In addition to the sites there have been a few previously conducted cultural resource inventories done in the areas. I've attached a list of these sites and reports. If you would like any further information regarding these sites or reports you may contact me at the number listed below. Thank you for consulting with us.

If you have any further questions or comments you may contact me at (406) 444-7767 or by e-mail at dmurdo@mt.gov.

Sincerely,

Damon Murdo
Cultural Records Manager

File: MISC/CONSULTANTS/2006

STATE HISTORIC PRESERVATION OFFICE

Cultural Resource Information Systems Report

Report Date:
01/19/2006

Site #	Twp	Rng	Sec	Qs	Site Type1	Site Type 2	Time Period	Owner	NR Status
24GA1053	4 S	3E	13	NE	Lithic Scatter	Rock Cairn(s)	No Indication of Time	Private	undetermined
24GA1043	4 S	4E	18	NE	Lithic Scatter	Processing Area	Prehistoric Middle Period	Private	undetermined
24GA1045	4 S	4E	18	NE	Lithic Scatter	Null	No Indication of Time	Private	undetermined
24GA1046	4 S	4E	18	NE	Lithic Scatter	Null	No Indication of Time	Private	undetermined
24GA1076	4 S	4E	18	NE	Lithic Scatter	Null	No Indication of Time	Private	undetermined
24GA1071	4 S	4E	18	NE	Historic Vehicular/Foot Bridge	Null	Historic More Than One Decade	Private	undetermined
24GA1064	4 S	4E	18	NE	Lithic Scatter	Null	No Indication of Time	State Owned	undetermined
24GA1052	4 S	4E	18	NE	Lithic Scatter	Null	No Indication of Time	Private	undetermined
24GA1042	4 S	4E	18	NW	Lithic Scatter	Historic Homestead/Farmstead	Prehistoric More Than One Period	Private	undetermined
24GA1044	4 S	4E	18	NW	Lithic Scatter	Lookout	No Indication of Time	Private	undetermined
24GA1047	4 S	4E	18	SE	Lithic Scatter	Null	No Indication of Time	Private	undetermined
24GA1048	4 S	4E	19	NE	Lithic Scatter	Null	No Indication of Time	Private	undetermined
24GA1528	4 S	4E	20	SW	Lithic Scatter	Null	No Indication of Time	No Data	undetermined
24GA0788	4 S	4E	28	SW	Historic Ranger Station	Historic CCC Camp	Historic More Than One Decade	Forest Service	undetermined
24GA0389	4 S	4E	33	NE	Historic Irrigation System	Null	Historic Period	Forest Service	undetermined
24GA0021	4 S	4E	35	NE	Lookout	Null	No Data	Forest Service	undetermined
24GA0986	4 S	4E	35	NE	Lithic Scatter	Chipping Station	No Indication of Time	Forest Service	undetermined
24GA0985	4 S	4E	35	NE	Lithic Scatter	Other	No Indication of Time	Forest Service	undetermined
24GA0987	4 S	4E	36	NW	Lithic Scatter	Workshop	No Indication of Time	Forest Service	undetermined
24GA0656	4 S	4E	36	Unk	Lithic Scatter	Workshop	Prehistoric Late Period	State Owned	undetermined
24GA0102	5 S	4E	15	NW	Lithic Scatter	Tipi Ring	Prehistoric Middle Period	Forest Service	undetermined
24GA1093	5 S	4E	15	NW	Historic Road/Trail	Historic Recreation/Tourism	Historic More Than One Decade	Forest Service	undetermined
24GA1134	5 S	4E	15	NW	Lithic Scatter	Null	1920-1930	Private	undetermined
24GA1134	5 S	4E	15	NW	Historic Residence	Historic Log Structure	1920-1930	Forest Service	undetermined
24GA1135	5 S	4E	15	NW	Historic Residence	Historic Log Structure	1920-1930	Private	undetermined
24GA1093	5 S	4E	16	SE	Historic Road/Trail	Historic Recreation/Tourism	Historic More Than One Decade	Forest Service	undetermined
24GA1199	5 S	4E	16	SE	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA0312	5 S	4E	24	SW	Lithic Scatter	Null	No Data	MDOT	undetermined
24GA0312	5 S	4E	24	SW	Lithic Scatter	Null	No Data	Forest Service	undetermined
24GA0103	5 S	4E	25	NE	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA1508	5 S	4E	25	SE	Historic Vehicular/Foot Bridge	Null	Historic More Than One Decade	MDOT	undetermined
24GA0690	5 S	4E	25	Unk	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA0661	5 S	4E	36	SE	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA1203	5 S	4E	36	SW	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA0317	5 S	4E	36	Unk	Lithic Scatter	Null	Prehistoric More Than One Period	MDOT Other	undetermined
24GA1381	5 S	5E	31	SE	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24MA2033	6 S	3E	34	SE	Historic Log Structure	Historic Outbuildings	Historic More Than One Decade	BLM	undetermined
24GA1003	6 S	3E	35	NW	Lithic Scatter	Null	No Indication of Time	Private	undetermined
24GA1004	6 S	3E	35	NW	Lithic Scatter	Lithic Scatter	No Indication of Time	Private	undetermined
24GA1002	6 S	3E	35	SE	Lithic Scatter	Null	Prehistoric Middle Period	Private	undetermined
24MA2038	6 S	3E	35	SE	Historic Mining	Rock Pile(s)	Historic More Than One Decade	BLM	undetermined
24GA0716	6 S	3E	36	NE	Historic Euro-American Site	Null	Historic Period	Private	NR Listed
24GA0872	6 S	4E	12	SE	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA0872	6 S	4E	12	SE	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA0877	6 S	4E	12	Unk	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA0320	6 S	4E	13	Unk	Other	Null	No Data	MDOT Other	undetermined
24GA1548	6 S	4E	23	Comb	Historic Log Structure	Null	No Indication of Time	No Data	undetermined

STATE HISTORIC PRESERVATION OFFICE

Cultural Resource Information Systems Report

Report Date: 01/19/2006

Site #	Twp	Rng	Sec	Qs	Site Type1	Site Type 2	Time Period	Owner	NR Status
24GA1549	6 S	4 E	23	Comb	Lithic Scatter	Null	No Indication of Time	No Data	undetermined
24GA0874	6 S	4 E	23	NW	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA1511	6 S	4 E	27	SW	Historic Vehicular/Foot Bridge	Null	Historic More Than One Decade	MDOT	undetermined
24MA2129	6 S	4 E	28	NW	Historic Irrigation System	Null	Historic More Than One Decade	Private	Unresolved
24GA0637	6 S	4 E	32	SE	Historic Recreation/Tourism	Historic Log Structure	1900-1909	Private	undetermined
24GA1001	6 S	4 E	32	SW	No Data	Null	No Data	Private	undetermined
24GA0318	6 S	4 E	32	Unk	Lithic Scatter	Null	Prehistoric Middle Period	No Data	undetermined
24GA1130	6 S	4 E	32	Unk	Lithic Scatter	Null	Prehistoric More Than One Period	Private	undetermined
24GA0689	6 S	4 E	32	Unk	Lithic Scatter	Null	Prehistoric Late Period	Private	undetermined
24GA1097	6 S	4 E	33	NE	Historic Mining	Null	Historic More Than One Decade	Other State Owned	undetermined
24GA0454	6 S	4 E	33	NW	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA0875	6 S	5 E	6	Comb	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA0876	6 S	5 E	6	Comb	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA0990	6 S	5 E	18	Oth	Chipping Station	Surface Stone Quarry	No Indication of Time	Forest Service	undetermined
24GA0989	6 S	5 E	18	SE	Lithic Scatter	Workshop	No Indication of Time	Forest Service	undetermined
24GA1143	7 S	4 E	5	Unk	Lithic Scatter	Null	Prehistoric More Than One Period	Private	undetermined
24GA1366	7 S	4 E	15	Comb	Historic Road/Trail	Null	Historic Period	Forest Service	undetermined
24GA1366	7 S	4 E	16	Comb	Historic Road/Trail	Null	Historic Period	Forest Service	undetermined
24GA1550	7 S	4 E	16	Comb	Lithic Scatter	Null	No Indication of Time	No Data	undetermined
24GA0162	7 S	4 E	16	SE	Lithic Scatter	Null	No Data	Forest Service	undetermined
24GA0396	7 S	4 E	16	SW	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA0844	7 S	4 E	16	SW	Historic Ranger Station	Null	Prehistoric More Than One Period	Forest Service	undetermined
24GA1181	7 S	4 E	16	Unk	Lithic Scatter	Lookout	Historic Period	Combination	undetermined
24GA1072	7 S	4 E	17	NE	Lithic Scatter	Null	No Indication of Time	National Wildlife Refuge	undetermined
24GA0319	7 S	4 E	17	Unk	Lithic Scatter	Other	No Data	No Data	undetermined
24GA0322	7 S	4 E	17	Unk	Lithic Scatter	Lithic Scatter	No Data	No Data	undetermined
24GA0033	7 S	4 E	21	NW	Lithic Scatter	Null	Prehistoric Late Period	Forest Service	undetermined
24GA1366	7 S	4 E	22	Comb	Historic Road/Trail	Null	Historic Period	Forest Service	undetermined
24GA1357	7 S	4 E	27	Comb	Historic Road/Trail	Null	Historic Period	Forest Service	undetermined
24GA1357	7 S	4 E	28	Comb	Historic Road/Trail	Null	Historic Period	Forest Service	undetermined
24GA1200	7 S	4 E	28	NE	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA0337	7 S	4 E	28	SE	Historic Euro-American Site	Cribbed Log Occupation Structure	Historic Period	Forest Service	undetermined
24GA0323	7 S	4 E	28	Unk	Lithic Scatter	Null	Prehistoric Paleo-Indian	Private	undetermined
24GA1160	7 S	4 E	33	NW	Lithic Scatter	Null	Prehistoric More Than One Period	MDOT Other	undetermined
24GA0458	8 S	4 E	4	NE	Rock Shelter or Cave	Null	No Indication of Time	National Wildlife Refuge	undetermined
24GA1213	8 S	4 E	4	NW	Lithic Scatter	Tipi Ring	No Indication of Time	Forest Service	undetermined
24GA1201	8 S	4 E	9	NW	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA1370	8 S	4 E	20	Comb	Historic Road/Trail	Null	Prehistoric More Than One Period	Forest Service	undetermined
24GA1370	8 S	4 E	21	Comb	Historic Road/Trail	Null	Prehistoric More Than One Period	Forest Service	undetermined
24GA1371	8 S	4 E	26	Comb	Historic Road/Trail	Null	Historic Period	Forest Service	undetermined
24GA0840	8 S	4 E	26	NE	Historic Ranger Station	Null	Prehistoric More Than One Period	Forest Service	CD
24GA0161	8 S	4 E	26	SE	Lithic Scatter	Null	No Data	Forest Service	undetermined
24GA1371	8 S	4 E	27	Comb	Historic Road/Trail	Null	Historic Period	Forest Service	undetermined
24GA1157	8 S	4 E	27	NW	Lithic Scatter	Null	Prehistoric More Than One Period	Forest Service	undetermined
24GA0478	8 S	4 E	27	SE	Historic Recreation/Tourism	Historic Dude Ranch	1890-1899	Forest Service	undetermined
24GA1211	8 S	4 E	27	SE	Lithic Scatter	Null	No Indication of Time	Private	undetermined
24GA1370	8 S	4 E	28	Comb	Historic Road/Trail	Null	Prehistoric More Than One Period	Forest Service	undetermined

STATE HISTORIC PRESERVATION OFFICE

Cultural Resource Information Systems Report

Report Date:
01/19/2006

Site #	Twp	Rng	Sec	Qs	Site Type1	Site Type 2	Time Period	Owner	NR Status
24GA0843	8 S	4 E	28	NE	Historic Ranger Station	Null	Prehistoric More Than One Period	Forest Service	undetermined
24GA1360	8 S	4 E	34	Comb	Historic Road/Trail	Null	Historic Period	Forest Service	undetermined
24GA1360	8 S	4 E	35	Comb	Historic Road/Trail	Null	Historic Period	Forest Service	undetermined
24GA1360	9 S	4 E	1	Comb	Historic Road/Trail	Null	Historic Period	Forest Service	undetermined
24GA0160	9 S	4 E	2	SW	Lithic Scatter	Null	No Data	Forest Service	undetermined
24GA0477	9 S	4 E	2	SW	Paleopoint Isolate	Bedrock Quarry	1920-1930	Forest Service	CD
24GA0414	9 S	4 E	10	NW	Lithic Scatter	Null	Prehistoric Middle Period	Forest Service	undetermined
24GA0413	9 S	4 E	10	SW	Lithic Scatter	Null	No Indication of Time	Forest Service	undetermined
24GA1156	9 S	4 E	11	NE	Lookout	Null	No Indication of Time	Private	undetermined
24GA0211	9 S	4 E	12	SE	Firehearths or Roasting Pits FCR	Lithic Scatter	No Indication of Time	Forest Service	undetermined
24GA1155	9 S	4 E	12	SW	Lithic Scatter	Lookout	No Indication of Time	Forest Service	undetermined
24GA1344	9 S	4 E	13	Comb	Historic Road/Trail	Null	1930-1939	Forest Service	undetermined
24GA1344	9 S	4 E	13	Comb	Historic Road/Trail	Null	1930-1939	Forest Service	undetermined
24GA1344	9 S	4 E	13	Comb	Historic Road/Trail	Null	1930-1939	Forest Service	undetermined
24GA1363	9 S	5 E	6	Comb	Historic Road/Trail	Null	Historic Period	Forest Service	undetermined
24GA1365	9 S	5 E	6	Comb	Historic Road/Trail	Null	Historic Period	Forest Service	undetermined
24GA0692	9 S	5 E	6	NE	Lithic Scatter	Null	Prehistoric Middle Period	Forest Service	undetermined
24GA1365	9 S	5 E	7	Comb	Historic Road/Trail	Null	Historic Period	Forest Service	undetermined
24GA0693	9 S	5 E	7	NW	Lithic Scatter	Null	Prehistoric Middle Period	Private	undetermined
24GA1162	9 S	5 E	7	SW	Lithic Scatter	Null	No Indication of Time	Private	undetermined
24GA0324	9 S	5 E	7	Unk	Other	Null	No Data	MDOT Other	undetermined

Township: 09S Range: 04E Section: 11

ALLEN WALTER E.
6/29/1988 *SAGE CREEK TRAIL #71*
CRABS Document Number: GA 1 3371

Township: 09S Range: 04E Section: 12

GALLATIN NATIONAL FOREST ANONYMOUS
GALLATIN NATIONAL FOREST (PREHISTORIC SITE COMPENDIUM)
CRABS Document Number: ZZ 1 10966
/ / 0

Township: 09S Range: 05E Section: 6

GALLATIN NATIONAL FOREST ANONYMOUS
GALLATIN NATIONAL FOREST (PREHISTORIC SITE COMPENDIUM)
CRABS Document Number: ZZ 1 10966
/ / 0

Township: 09S Range: 05E Section: 7

WRIGHT GARY A.
4/ /1979 *YELLOWSTONE AND GRAND TETON NATIONAL PARKS PRECONSTRUCTION ARCHAEOLOGICAL SURVEYS - 1978*
CRABS Document Number: YE 6 11595

Township: 09S Range: 05E Section: 7

NAPTON L. KYLE
/ /1966 *CANYON AND VALLEY: PRELIMINARY ARCHAEOLOGICAL SURVEY IN THE GALLATIN AREA*
CRABS Document Number: ZZ 6 15683

Township: 09S Range: 05E Section: 8

WRIGHT GARY A.
4/ /1979 *YELLOWSTONE AND GRAND TETON NATIONAL PARKS PRECONSTRUCTION ARCHAEOLOGICAL SURVEYS - 1978*
CRABS Document Number: YE 6 11595

Township: 04S Range: 04E Section: 17

AABERG STEPHEN A.

4/1/1994 *BOTANICAL AND ETHNOBOTANICAL ASPECTS OF THE CHERRY/POLE/SPANISH CREEKS ARCHAEOLOGICAL RESEARCH PROJECT ON TURNER ENTERPRISE'S FLYING D RANCH*

CRABS Document Number: MA 6 17450

Township: 04S Range: 04E Section: 18

PLATT STEVE

9/20/1993 *SOUTH OF SPANISH CREEK*

CRABS Document Number: GA 4 15497

Township: 04S Range: 04E Section: 20

BAILEY MARILYN

/ /0 *CULTURAL RESOURCE REPORT - KING ESTATE CITY OF WEST YELLOWSTONE EXCHANGE OFFERED LANDS*

CRABS Document Number: GA 1 3250

Township: 04S Range: 04E Section: 20

ALLEN WALTER E.

2/15/1998 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*

CRABS Document Number: GA 1 21862

Township: 04S Range: 04E Section: 21

SCHWAB DAVID C. AND MARK F. BAUMLER

1/ /1991 *A PRELIMINARY ARCHAEOLOGICAL SURVEY OF THE FLYING D RANCH*

CRABS Document Number: MA 6 13026

Township: 04S Range: 04E Section: 28

SAMUELSON ANN E.

11/24/1982 *INDIAN RIDGE TRAIL #2 AND PROPOSED PARKING AREA*

CRABS Document Number: GA 1 3292

Township: 04S Range: 04E Section: 28

CAYWOOD JANENE M., ET AL.

3/11/1991 *EVALUATION OF REGION 1 FOREST SERVICE-OWNED BUILDINGS FOR ELIGIBILITY TO THE NATIONAL REGISTER OF HISTORIC PLACES*

CRABS Document Number: ZZ 1 13017

Township: 04S Range: 04E Section: 28

SAMUELSON ANN E.

8/22/1983 *SHENANGO CREEK TIMBER SALE*

CRABS Document Number: GA 1 13356

State Historic Preservation Office

Cultural Resource Annotated Bibliography System Report

Report Date: 01/19/2006

Township: 04S Range: 04E Section: 28

ALLEN WALTER E.

7/2/1999 *THE MUSEUM OF THE ROCKIES AND GALLATIN NATIONAL FOREST - A PARTNERSHIP AT THE HISTORIC SQUAW CREEK RANGER STATION*

CRABS Document Number: GA 1 22428

Township: 04S Range: 04E Section: 28

ALLEN WALTER E.

2/14/2000 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*

CRABS Document Number: GA 1 22718

Township: 04S Range: 04E Section: 29

ALLEN WALTER E.

2/14/2000 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*

CRABS Document Number: GA 1 22718

Township: 04S Range: 04E Section: 29

ALLEN WALTER E.

2/15/1998 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*

CRABS Document Number: GA 1 21862

Township: 04S Range: 04E Section: 29

JACKMAN JANET A.

11/16/1992 *SOUTH DISTRICT ASPEN REGENERATION SALE*

CRABS Document Number: GA 1 14519

Township: 04S Range: 04E Section: 29

SAMUELSON ANN E.

11/24/1982 *INDIAN RIDGE TRAIL #2 AND PROPOSED PARKING AREA*

CRABS Document Number: GA 1 3292

Township: 04S Range: 04E Section: 29

ALLEN WALTER E.

2/14/2000 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*

CRABS Document Number: GA 1 22718

Township: 04S Range: 04E Section: 29

BAILEY MARILYN

/ /0 *CULTURAL RESOURCE REPORT - KING ESTATE CITY OF WEST YELLOWSTONE EXCHANGE OFFERED LANDS*

CRABS Document Number: GA 1 3250

Township: 04S Range: 04E Section: 30
ALLEN WALTER E.
2/15/1998 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*
CRABS Document Number: GA 1 21862

Township: 04S Range: 04E Section: 32
SAMUELSON ANN E.
11/24/1982 *INDIAN RIDGE TRAIL #2 AND PROPOSED PARKING AREA*
CRABS Document Number: GA 1 3292

Township: 04S Range: 04E Section: 32
ALLEN WALTER E.
2/15/1998 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*
CRABS Document Number: GA 1 21862

Township: 04S Range: 04E Section: 32
ALLEN WALTER E.
2/14/2000 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*
CRABS Document Number: GA 1 22718

Township: 04S Range: 04E Section: 32
ALLEN WALTER E.
2/15/1998 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*
CRABS Document Number: GA 1 21862

Township: 04S Range: 04E Section: 33
SAMUELSON ANN E.
11/24/1982 *INDIAN RIDGE TRAIL #2 AND PROPOSED PARKING AREA*
CRABS Document Number: GA 1 3292

Township: 04S Range: 04E Section: 33
SAMUELSON ANN E.
8/22/1983 *SHENANGO CREEK TIMBER SALE*
CRABS Document Number: GA 1 13356

Township: 04S Range: 04E Section: 33
ALLEN WALTER E.
2/15/1998 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*
CRABS Document Number: GA 1 21862

Township: 04S Range: 04E Section: 33
ALLEN WALTER E.
2/14/2000 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*
CRABS Document Number: GA 1 22718

Township: 04S Range: 04E Section: 33
JACKMAN JANET A.
11/16/1992 *SOUTH DISTRICT ASPEN REGENERATION SALE*
CRABS Document Number: GA 1 14519

Township: 04S Range: 04E Section: 33
ALLEN WALTER E.
2/14/2000 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*
CRABS Document Number: GA 1 22718

Township: 04S Range: 04E Section: 33
RYAN J. MICHAEL
5/30/1985 *MOUNTAIN BELL SQUAW CREEK BURIED TELEPHONE CABLE*
CRABS Document Number: GA 1 3329

Township: 04S Range: 04E Section: 34
JACKMAN JANET A.
11/17/1992 *SPIRE ROCK CAMPGROUND TIMBER SALE*
CRABS Document Number: GA 1 14442

Township: 04S Range: 04E Section: 34
RYAN J. MICHAEL
5/30/1985 *MOUNTAIN BELL SQUAW CREEK BURIED TELEPHONE CABLE*
CRABS Document Number: GA 1 3329

Township: 04S Range: 04E Section: 34
ALLEN WALTER E.
2/18/1997 *STORM CATTLE PRESCRIBED BURN (IN ZZ- 1- 18893 GALLATIN NATIONAL FOREST: REPORT ON HERITAGE RESOURCES FY96)*
CRABS Document Number: GA 1 18901

Township: 04S Range: 04E Section: 34
GRIFFIN KRISTIN L.
4/24/1995 *GARNET MT. TRAILHEAD REHAB PROJECT*
CRABS Document Number: GA 1 16932

Township: 04S Range: 04E Section: 35

JACKMAN JANET A.

11/17/1992 *SPIRE ROCK CAMPGROUND TIMBER SALE*

CRABS Document Number: GA 1 14442

Township: 04S Range: 04E Section: 35

ALLEN WALT & TOM BALLARD

1/25/2005 *GALLATIN NATIONAL FOREST HERITAGE PROGRAM ANNUAL REPORT TO THE MONTANA STATE HISTORIC PRESERVATION OFFICE, IN MONTANA*

CRABS Document Number: ZZ 1 27951

Township: 04S Range: 04E Section: 36

GALLATIN NATIONAL FOREST ANONYMOUS

/ /0 *GALLATIN NATIONAL FOREST (PREHISTORIC SITE COMPENDIUM)*

CRABS Document Number: ZZ 1 10966

Township: 05S Range: 04E Section: 4

ALLEN WALTER E.

3/1/2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 05S Range: 04E Section: 4

ALLEN WALTER E.

3/1/2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 05S Range: 04E Section: 5

ALLEN WALTER E.

3/1/2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 05S Range: 04E Section: 8

ALLEN WALTER E.

3/1/2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 05S Range: 04E Section: 9
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 05S Range: 04E Section: 15
ALLEN WALTER E.
2/ 18/ 1997 *CASCADE CREEK CABIN ADDITION (IN ZZ- 1- 18893 GALLATIN NATIONAL FOREST: REPORT ON HERITAGE RESOURCES FY96)*
CRABS Document Number: GA 1 18895

Township: 05S Range: 04E Section: 15
JACKMAN JANET A.
11/ 16/ 1992 *CASCADE CREEK FIREWOOD SALE*
CRABS Document Number: GA 1 14463

Township: 05S Range: 04E Section: 15
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 05S Range: 04E Section: 15
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 05S Range: 04E Section: 16
GALLATIN NATIONAL FOREST ANONYMOUS
GALLATIN NATIONAL FOREST (PREHISTORIC SITE COMPENDIUM)
CRABS Document Number: ZZ 1 10966
/ / 0

Township: 05S Range: 04E Section: 16
ALLEN WALT & TOM BALLARD
3/ 16/ 2004 *GALLATIN NATIONAL FOREST HERITAGE PROGRAM ANNUAL REPORT TO THE MONTANA STATE PRESERVATION OFFICE FY2003*
CRABS Document Number: ZZ 1 27069

State Historic Preservation Office

Cultural Resource Annotated Bibliography System Report

Report Date: 01/19/2006

Township: 05S Range: 04E Section: 16

ALLEN WALTER E.

11/27/1995 *CULTURAL RESOURCE INVENTORY FOR PORCUPINE WATERSHED RESTORATION*

CRABS Document Number: GA 1 19886

Township: 05S Range: 04E Section: 16

ALLEN WALTER E.

3/1/2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 05S Range: 04E Section: 16

JACKMAN JANET A.

11/16/1992 *CASCADE CREEK FIREWOOD SALE*

CRABS Document Number: GA 1 14463

Township: 05S Range: 04E Section: 23

ALLEN WALTER E.

3/1/2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 05S Range: 04E Section: 24

SAMUELSON ANN E.

11/29/1983 *CULTURAL RESOURCE REPORT ON THE GREEK CREEK TIMBER SALE*

CRABS Document Number: GA 1 3309

Township: 05S Range: 04E Section: 24

ALLEN WALTER E.

3/1/2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 05S Range: 04E Section: 25

GALLATIN NATIONAL FOREST ANONYMOUS

GALLATIN NATIONAL FOREST (PREHISTORIC SITE COMPENDIUM)

CRABS Document Number: ZZ 1 10966

/ /0

Township: 05S Range: 04E Section: 25

ALLEN WALT & TOM BALLARD

3/16/2004 *GALLATIN NATIONAL FOREST HERITAGE PROGRAM ANNUAL REPORT TO THE MONTANA STATE PRESERVATION OFFICE FY2003*

CRABS Document Number: ZZ 1 27069

Township: 05S Range: 04E Section: 25
AXLINE JON A.
3/ /2000 *INVENTORY AND ASSESSMENT: REINFORCED CONCRETE T-BEAM BRIDGES*
CRABS Document Number: ZZ 4 24227

Township: 05S Range: 04E Section: 25
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 05S Range: 04E Section: 25
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 05S Range: 04E Section: 36
GALLATIN NATIONAL FOREST ANONYMOUS
/ / 0 *GALLATIN NATIONAL FOREST (PREHISTORIC SITE COMPENDIUM)*
CRABS Document Number: ZZ 1 10966

Township: 05S Range: 04E Section: 36
NAPTON L. KYLE
/ /1966 *CANYON AND VALLEY: PRELIMINARY ARCHAEOLOGICAL SURVEY IN THE GALLATIN AREA*
CRABS Document Number: ZZ 6 15683

Township: 05S Range: 04E Section: 36
LAHREN LARRY A.
7/ /1976 *SURFACE RECONNAISSANCE, INVESTIGATION AND EVALUATION OF CULTURAL RESOURCES ON PROPOSED IMPACT TRACTS OF FOREST SERVICE LAND IN THE BIG TIMBER, GALLATIN, HEBGEN LAKE AND LIVINGSTON RANGER DISTRICTS*
CRABS Document Number: ZZ 1 10744

Township: 05S Range: 04E Section: 36
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 05S Range: 04E Section: 36
AXLINE JON A.
5/27/1999 *GALLATIN CANYON SAFETY IMPROVEMENT - PHASE II*
CRABS Document Number: GA 4 22055

Township: 05S Range: 04E Section: 36
ALLEN WALT & TOM BALLARD
3/16/2004 *GALLATIN NATIONAL FOREST HERITAGE PROGRAM ANNUAL REPORT TO THE MONTANA STATE PRESERVATION OFFICE FY2003*
CRABS Document Number: ZZ 1 27069

Township: 05S Range: 04E Section: 36
GALLATIN NATIONAL FOREST ANONYMOUS
GALLATIN NATIONAL FOREST (PREHISTORIC SITE COMPENDIUM)
CRABS Document Number: ZZ 1 10966
/ / 0

Township: 05S Range: 05E Section: 30
SAMUELSON ANN E.
11/29/1983 *CULTURAL RESOURCE REPORT ON THE GREEK CREEK TIMBER SALE*
CRABS Document Number: GA 1 3309

Township: 05S Range: 05E Section: 30
ALLEN WALTER E.
3/1/2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 05S Range: 05E Section: 31
BERGSTROM MICHAEL W. AND WALTER E. ALLEN
7/31/1995 *BSL SAMPLE SURVEY: UPPER MOOSE AND TAMPHERY (IN ZZ- 1- 18893 GALLATIN NATIONAL FOREST: REPORT ON HERITAGE RESOURCES FY96)*
CRABS Document Number: GA 1 18904

Township: 06S Range: 03E Section: 26
LAHREN LARRY A.
/ / 0 *REPORT ON PRELIMINARY ARCHAEOLOGICAL INVESTIGATIONS IN THE WEST FORK OF THE GALLATIN CANYON*
CRABS Document Number: GA 1 15189

Township: 06S Range: 03E Section: 35
SHARROCK SUSAN R., ET AL.
10/ /1975 *CONTRIBUTIONS TO ANTHROPOLOGY NUMBER 5, COLLECTED PAPERS IN HIGHWAY SALVAGE ARCHAEOLOGY 1972-74*

CRABS Document Number: ZZ 4 10766

Township: 06S Range: 03E Section: 35
LAHREN LARRY A.
/ /0 *REPORT ON PRELIMINARY ARCHAEOLOGICAL INVESTIGATIONS IN THE WEST FORK OF THE GALLATIN CANYON*
CRABS Document Number: GA 1 15189

Township: 06S Range: 03E Section: 35
O'BRIEN LYNN, ET AL.
1/ 1/ 1972 *REPORT OF THE 1972 HIGHWAY ARCHAEOLOGICAL RECONNAISSANCE SURVEY*
CRABS Document Number: ZZ 4 15940

Township: 06S Range: 03E Section: 36
LAHREN LARRY A.
/ /0 *REPORT ON PRELIMINARY ARCHAEOLOGICAL INVESTIGATIONS IN THE WEST FORK OF THE GALLATIN CANYON*
CRABS Document Number: GA 1 15189

Township: 06S Range: 04E Section: 1
MOORE CONNIE N.
8/ 30/ 1985 *KARST SLIDE*
CRABS Document Number: GA 4 3426

Township: 06S Range: 04E Section: 1
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 1
ALLEN WALT & TOM BALLARD
1/ 25/ 2005 *GALLATIN NATIONAL FOREST HERITAGE PROGRAM ANNUAL REPORT TO THE MONTANA STATE HISTORIC PRESERVATION OFFICE, IN MONTANA*
CRABS Document Number: ZZ 1 27951

Township: 06S Range: 04E Section: 1
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 2

ALLEN WALTER E.

3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 11

ALLEN WALTER E.

3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 12

RYAN J. MICHAEL

5/ 7/ 1985 *DAN COX GARAGE CONSTRUCTION*

CRABS Document Number: GA 1 3328

Township: 06S Range: 04E Section: 12

ALLEN WALTER E.

3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 12

ALLEN WALTER E.

3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 12

ALLEN WALT & TOM BALLARD

3/ 16/ 2004 *GALLATIN NATIONAL FOREST HERITAGE PROGRAM ANNUAL REPORT TO THE MONTANA STATE PRESERVATION OFFICE FY2003*

CRABS Document Number: ZZ 1 27069

Township: 06S Range: 04E Section: 12
ALLEN WALTER E.
2/14/2000 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*
CRABS Document Number: GA 1 22718

Township: 06S Range: 04E Section: 12
JACKMAN JANET A.
7/24/1990 *DURNAM SALVAGE SALE*
CRABS Document Number: GA 1 15201

Township: 06S Range: 04E Section: 13
GALLATIN NATIONAL FOREST ANONYMOUS
GALLATIN NATIONAL FOREST (PREHISTORIC SITE COMPENDIUM)
CRABS Document Number: ZZ 1 10966
/ / 0

Township: 06S Range: 04E Section: 13
ALLEN WALTER E.
3/1/2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 13
ALLEN WALTER E.
3/1/2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 13
NAPTON L. KYLE
/ /1966 *CANYON AND VALLEY: PRELIMINARY ARCHAEOLOGICAL SURVEY IN THE GALLATIN AREA*
CRABS Document Number: ZZ 6 15683

Township: 06S Range: 04E Section: 13
JACKMAN JANET A.
8/6/1992 *PORTAL CREEK HELICOPTER LANDINGS (FOR THE PORTAL CREEK HELICOPTER SALVAGE TIMBER SALE)*
CRABS Document Number: GA 1 13936

Township: 06S Range: 04E Section: 14
ALLEN WALTER E.
3/1/2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 14
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 15
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 21
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 21
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 22
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 22
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 22
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 23
JACKMAN JANET A.
2/ 5/ 1991 *DEER CREEK FIREWOOD SALE*
CRABS Document Number: GA 1 15205

Township: 06S Range: 04E Section: 23
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 23
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 23
ALLEN WALT & TOM BALLARD
3/ 16/ 2004 *GALLATIN NATIONAL FOREST HERITAGE PROGRAM ANNUAL REPORT TO THE MONTANA STATE PRESERVATION OFFICE FY2003*
CRABS Document Number: ZZ 1 27069

Township: 06S Range: 04E Section: 23
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 27
AXLINE JON A.
5/ 27/ 1999 *GALLATIN CANYON SAFETY IMPROVEMENT - PHASE II*
CRABS Document Number: GA 4 22055

Township: 06S Range: 04E Section: 27
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 27
ALLEN WALTER E.
2/ 18/ 1997 *BULL PASTURE PRESCRIBED BURN (IN ZZ- 1- 18893 GALLATIN NATIONAL FOREST: REPORT ON HERITAGE RESOURCES FY96)*
CRABS Document Number: GA 1 18894

Township: 06S Range: 04E Section: 27
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 27
AXLINE JON A.
3/ / 2000 *INVENTORY AND ASSESSMENT: REINFORCED CONCRETE T-BEAM BRIDGES*
CRABS Document Number: ZZ 4 24227

Township: 06S Range: 04E Section: 27
JACKMAN JANET A.
2/ 5/ 1991 *DEER CREEK PRODUCT SALE*
CRABS Document Number: GA 1 15208

Township: 06S Range: 04E Section: 28
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 28
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 29
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 32
LAHREN LARRY A.
/ / 0 *REPORT ON PRELIMINARY ARCHAEOLOGICAL INVESTIGATIONS IN THE WEST FORK OF THE GALLATIN CANYON*
CRABS Document Number: GA 1 15189

Township: 06S Range: 04E Section: 32
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 32
NAPTON L. KYLE
/ / 1966 *CANYON AND VALLEY: PRELIMINARY ARCHAEOLOGICAL SURVEY IN THE GALLATIN AREA*
CRABS Document Number: ZZ 6 15683

Township: 06S Range: 04E Section: 32
O'BRIEN LYNN, ET AL.
1/ 1/ 1972 *REPORT OF THE 1972 HIGHWAY ARCHAEOLOGICAL RECONNAISSANCE SURVEY*
CRABS Document Number: ZZ 4 15940

Township: 06S Range: 04E Section: 32
AXLINE JON A., ET AL.
9/ 5/ 1996 *BICYCLE/PEDESTRIANS TRAIL - BIG SKY*
CRABS Document Number: GA 4 18421

Township: 06S Range: 04E Section: 33
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 06S Range: 04E Section: 33

ALLEN WALTER E.

3/1/2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*

CRABS Document Number: ZZ 1 25268

Township: 06S Range: 05E Section: 6

JACKMAN JANET A.

2/21/1991 *MOOSE CREEK TIMBER SALE*

CRABS Document Number: GA 1 15203

Township: 06S Range: 05E Section: 6

ALLEN WALT & TOM BALLARD

3/16/2004 *GALLATIN NATIONAL FOREST HERITAGE PROGRAM ANNUAL REPORT TO THE MONTANA STATE PRESERVATION OFFICE FY2003*

CRABS Document Number: ZZ 1 27069

Township: 06S Range: 05E Section: 6

BERGSTROM MICHAEL W. AND WALTER E. ALLEN

7/31/1995 *BSL SAMPLE SURVEY: UPPER MOOSE AND TAMPHERY (IN ZZ- 1- 18893 GALLATIN NATIONAL FOREST: REPORT ON HERITAGE RESOURCES FY96)*

CRABS Document Number: GA 1 18904

Township: 06S Range: 05E Section: 7

BERGSTROM MICHAEL W. AND WALTER E. ALLEN

7/31/1995 *BSL SAMPLE SURVEY: UPPER MOOSE AND TAMPHERY (IN ZZ- 1- 18893 GALLATIN NATIONAL FOREST: REPORT ON HERITAGE RESOURCES FY96)*

CRABS Document Number: GA 1 18904

Township: 06S Range: 05E Section: 7

ALLEN WALTER E.

11/28/1989 *TAMPHERY CREEK TIMBER SALE*

CRABS Document Number: GA 1 3392

Township: 06S Range: 05E Section: 18

ALLEN WALTER E.

11/28/1989 *TAMPHERY CREEK TIMBER SALE*

CRABS Document Number: GA 1 3392

Township: 06S Range: 05E Section: 18

ALLEN WALT & TOM BALLARD

3/16/2004 *GALLATIN NATIONAL FOREST HERITAGE PROGRAM ANNUAL REPORT TO THE MONTANA STATE PRESERVATION OFFICE FY2003*

CRABS Document Number: ZZ 1 27069

Township: 06S Range: 05E Section: 18
JACKMAN JANET A.
8/ 6/ 1992 *PORTAL CREEK HELICOPTER LANDINGS (FOR THE PORTAL CREEK HELICOPTER SALVAGE TIMBER SALE)*
CRABS Document Number: GA 1 13936

Township: 07S Range: 04E Section: 5
AXLINE JON A., ET AL.
9/ 5/ 1996 *BICYCLE/PEDESTRIANS TRAIL - BIG SKY*
CRABS Document Number: GA 4 18421

Township: 07S Range: 04E Section: 8
AXLINE JON A., ET AL.
9/ 5/ 1996 *BICYCLE/PEDESTRIANS TRAIL - BIG SKY*
CRABS Document Number: GA 4 18421

Township: 07S Range: 04E Section: 15
BAILEY MARILYN
7/ 6/ 1981 *CULTURAL RESOURCE REPORT PORCUPINE CREEK ROAD COST SHARE PROJECT*
CRABS Document Number: GA 1 3270

Township: 07S Range: 04E Section: 16
BAILEY MARILYN
7/ 6/ 1981 *CULTURAL RESOURCE REPORT PORCUPINE CREEK ROAD COST SHARE PROJECT*
CRABS Document Number: GA 1 3270

Township: 07S Range: 04E Section: 16
ALLEN WALTER E.
3/ 1/ 2002 *CULTURAL RESOURCE INVENTORY OF THE ANNUAL REPORT FOR GALLATIN NATIONAL FOREST, FY 2001*
CRABS Document Number: ZZ 1 25268

Township: 07S Range: 04E Section: 16
ALLEN WALTER E.
2/ 15/ 1998 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*
CRABS Document Number: GA 1 21862

Township: 07S Range: 04E Section: 16
CAYWOOD JANENE M., ET AL.
3/11/1991 *EVALUATION OF REGION 1 FOREST SERVICE-OWNED BUILDINGS FOR ELIGIBILITY TO THE NATIONAL REGISTER OF HISTORIC PLACES*
CRABS Document Number: ZZ 1 13017

Township: 07S Range: 04E Section: 16
LAHREN LARRY A.
7/ /1976 *SURFACE RECONNAISSANCE, INVESTIGATION AND EVALUATION OF CULTURAL RESOURCES ON PROPOSED IMPACT TRACTS OF FOREST SERVICE LAND IN THE BIG TIMBER, GALLATIN, HEBGEN LAKE AND LIVINGSTON RANGER DISTRICTS*
CRABS Document Number: ZZ 1 10744

Township: 07S Range: 04E Section: 17
NAPTON L. KYLE
/ /1966 *CANYON AND VALLEY: PRELIMINARY ARCHAEOLOGICAL SURVEY IN THE GALLATIN AREA*
CRABS Document Number: ZZ 6 15683

Township: 07S Range: 04E Section: 17
AXLINE JON A., ET AL.
9/5/1996 *BICYCLE/PEDESTRIANS TRAIL - BIG SKY*
CRABS Document Number: GA 4 18421

Township: 07S Range: 04E Section: 17
FERGUSON DAVID M.
11/15/1994 *TESTING AT 24GA1072*
CRABS Document Number: GA 6 16624

Township: 07S Range: 04E Section: 17
FERGUSON DAVID M.
8/18/1994 *CLASS III CRI WITHIN GALLATIN WILDLIFE MANAGEMENT AREA*
CRABS Document Number: GA 6 16132

Township: 07S Range: 04E Section: 20
RYAN J. MICHAEL
2/28/1986 *DOE CREEK LAND EXCHANGE*
CRABS Document Number: GA 1 3336

Township: 07S Range: 04E Section: 20

JACKMAN JANET A.
2/14/1991 *BRASK - 320 RANCH LAND EXCHANGE*
CRABS Document Number: GA 1 15206

Township: 07S Range: 04E Section: 21

RYAN J. MICHAEL
2/28/1986 *DOE CREEK LAND EXCHANGE*
CRABS Document Number: GA 1 3336

Township: 07S Range: 04E Section: 22

BAILEY MARILYN
7/6/1981 *CULTURAL RESOURCE REPORT PORCUPINE CREEK ROAD COST SHARE PROJECT*
CRABS Document Number: GA 1 3270

Township: 07S Range: 04E Section: 28

BAILEY MARILYN
8/13/1981 *CULTURAL RESOURCE REPORT RAINBOW CABINS*
CRABS Document Number: GA 1 3272

Township: 07S Range: 04E Section: 28

NAPTON L. KYLE
/ /1966 *CANYON AND VALLEY: PRELIMINARY ARCHAEOLOGICAL SURVEY IN THE GALLATIN AREA*
CRABS Document Number: ZZ 6 15683

Township: 07S Range: 04E Section: 28

GALLATIN NATIONAL FOREST ANONYMOUS
GALLATIN NATIONAL FOREST (PREHISTORIC SITE COMPENDIUM)
CRABS Document Number: ZZ 1 10966
/ /0

Township: 07S Range: 04E Section: 28

JACKMAN JANET A.
11/17/1992 *BRASK 320-RANCH LAND EXCHANGE 1992*
CRABS Document Number: GA 1 14543

Township: 07S Range: 04E Section: 32

ALLEN WALTER E.
2/14/2000 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*
CRABS Document Number: GA 1 22718

Township: 07S Range: 04E Section: 33

GALLATIN NATIONAL FOREST
ANONYMOUS
GALLATIN NATIONAL FOREST (PREHISTORIC SITE COMPENDIUM)
CRABS Document Number: ZZ 1 10966
/ / 0

Township: 07S Range: 04E Section: 33

ALLEN
WALTER E.
2/14/2000
GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES
CRABS Document Number: GA 1 22718

Township: 08S Range: 04E Section: 4

GALLATIN NATIONAL FOREST
ANONYMOUS
GALLATIN NATIONAL FOREST (PREHISTORIC SITE COMPENDIUM)
CRABS Document Number: ZZ 1 10966
/ / 0

Township: 08S Range: 04E Section: 9

GALLATIN NATIONAL FOREST
ANONYMOUS
GALLATIN NATIONAL FOREST (PREHISTORIC SITE COMPENDIUM)
CRABS Document Number: ZZ 1 10966
/ / 0

Township: 08S Range: 04E Section: 20

ALLEN
WALTER E.
2/18/1997
CINNAMON PRESCRIBED BURN
CRABS Document Number: GA 1 18898

Township: 08S Range: 04E Section: 21

ALLEN
WALTER E.
2/18/1997
CINNAMON PRESCRIBED BURN
CRABS Document Number: GA 1 18898

Township: 08S Range: 04E Section: 22

CARPENTER
SCOTT
7/20/2005
CULTURAL RESOURCES INVENTORY OF THE ALTMAN FAMILY PROPERTY SALE IN GALLATIN COUNTY, MONTANA
CRABS Document Number: GA 6 27964

Township: 08S Range: 04E Section: 26

LAHREN
LARRY A.
7/ /1976
SURFACE RECONNAISSANCE, INVESTIGATION AND EVALUATION OF CULTURAL RESOURCES ON PROPOSED IMPACT TRACTS OF FOREST SERVICE LAND IN THE BIG TIMBER, GALLATIN, HEBGEN LAKE AND LIVINGSTON RANGER DISTRICTS

CRABS Document Number: ZZ 1 10744

Township: 08S Range: 04E Section: 26
ALLEN WALT
11/27/1995 *BUFFALO HORN STREAM STABILIZATION*
CRABS Document Number: GA 1 19888

Township: 08S Range: 04E Section: 26
ALLEN WALTER E.
10/13/1989 *BUFFALO HORN RIP-RAP PROJECT*
CRABS Document Number: GA 1 3377

Township: 08S Range: 04E Section: 26
GRIFFIN KRISTIN L. AND WALT ALLEN
6/26/1995 *CULTURAL RESOURCE INVENTORY FOR TROY CREEK LEX*
CRABS Document Number: GA 1 19887

Township: 08S Range: 04E Section: 27
ALLEN WALTER E.
10/13/1989 *BUFFALO HORN RIP-RAP PROJECT*
CRABS Document Number: GA 1 3377

Township: 08S Range: 04E Section: 27
GALLATIN NATIONAL FOREST ANONYMOUS
GALLATIN NATIONAL FOREST (PREHISTORIC SITE COMPENDIUM)
CRABS Document Number: ZZ 1 10966
/ / 0

Township: 08S Range: 04E Section: 27
RYAN J. MICHAEL
9/21/1987 *COVERED WAGON GUEST RANCH SPECIAL USE PERMIT*
CRABS Document Number: GA 1 3355

Township: 08S Range: 04E Section: 27
JACKMAN JANET A.
11/17/1992 *BRASK 320-RANCH LAND EXCHANGE 1992*
CRABS Document Number: GA 1 14543

Township: 08S Range: 04E Section: 27

WOOD WILLIAM C.
6/19/1979 *320 RANCH ACCESS ROAD*
CRABS Document Number: GA 1 15214

Township: 08S Range: 04E Section: 27

GALLATIN NATIONAL FOREST ANONYMOUS
/ /1973 *PORCUPINE BUFFALO HORN AREA (PORCUPINE CREEK, BUFFALO HORN CREEK, COW FLATS, BUFFALO HORN CREEK/TOM MINER BASIN DIVIDE, 320 RANCH AREA, RAINBOW RANCH AREA DIVIDE, BUFFALO HORN CREEK/RAMSHORN LAKE AREA*
CRABS Document Number: GA 1 15232

Township: 08S Range: 04E Section: 27

ALLEN WALTER E.
2/15/1998 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*
CRABS Document Number: GA 1 21862

Township: 08S Range: 04E Section: 27

JACKMAN JANET A.
2/14/1991 *BRASK - 320 RANCH LAND EXCHANGE*
CRABS Document Number: GA 1 15206

Township: 08S Range: 04E Section: 28

ALLEN WALTER E.
2/18/1997 *CINNAMON PRESCRIBED BURN*
CRABS Document Number: GA 1 18898

Township: 08S Range: 04E Section: 28

ALLEN WALTER E.
2/15/1998 *GALLATIN NATIONAL FOREST ANNUAL REPORT ON HERITAGE RESOURCES*
CRABS Document Number: GA 1 21862

Township: 08S Range: 04E Section: 33

ALLEN WALTER E.
5/20/1988 *SPECIAL USE PIPELINE TO THE 320 RANCH*
CRABS Document Number: GA 1 3364

Township: 08S Range: 04E Section: 34

ALLEN WALTER E.
5/20/1988 *SPECIAL USE PIPELINE TO THE 320 RANCH*
CRABS Document Number: GA 1 3364

Township: 08S Range: 04E Section: 34
JACKMAN JANET A.
2/14/1991 *BRASK - 320 RANCH LAND EXCHANGE*
CRABS Document Number: GA 1 15206

Township: 08S Range: 04E Section: 34
JACKMAN JANET A.
11/17/1992 *BRASK 320-RANCH LAND EXCHANGE 1992*
CRABS Document Number: GA 1 14543

Township: 09S Range: 04E Section: 2
BAILEY MARILYN
9/14/1981 *CULTURAL RESOURCE REPORT TAYLOR FORK BURIED TELEPHONE LINE*
CRABS Document Number: GA 1 3271

Township: 09S Range: 04E Section: 2
RYAN J. MICHAEL
3/13/1987 *TAYLOR FORK ROAD REHABILITATION PROJECT*
CRABS Document Number: GA 1 3340

Township: 09S Range: 04E Section: 2
ALLEN WALTER E.
10/24/1989 *COVERED WAGON RANCH IMPROVEMENT*
CRABS Document Number: GA 1 3378

Township: 09S Range: 04E Section: 2
RYAN J. MICHAEL
9/21/1987 *COVERED WAGON GUEST RANCH SPECIAL USE PERMIT*
CRABS Document Number: GA 1 3355

Township: 09S Range: 04E Section: 2
ALLEN WALTER E.
10/ /1988 *TAYLOR FORK - GALLATIN RIVER CONFLUENCE AREA SURVEY*
CRABS Document Number: GA 1 3375

Township: 09S Range: 04E Section: 2
LAHREN LARRY A.
7/ /1976 *SURFACE RECONNAISSANCE, INVESTIGATION AND EVALUATION OF CULTURAL RESOURCES ON PROPOSED IMPACT TRACTS OF FOREST SERVICE LAND IN THE BIG TIMBER, GALLATIN, HEBGEN LAKE AND LIVINGSTON RANGER DISTRICTS*
CRABS Document Number: ZZ 1 10744

State Historic Preservation Office

Cultural Resource Annotated Bibliography System Report

Report Date: 01/19/2006

Township: 09S Range: 04E Section: 10

BAILEY MARILYN

9/14/1981 *CULTURAL RESOURCE REPORT TAYLOR FORK BURIED TELEPHONE LINE*

CRABS Document Number: GA 1 3271

Township: 09S Range: 04E Section: 10

ALLEN WALTER E.

10/ /1988 *TAYLOR FORK - GALLATIN RIVER CONFLUENCE AREA SURVEY*

CRABS Document Number: GA 1 3375

Township: 09S Range: 04E Section: 10

RYAN J. MICHAEL

3/13/1987 *TAYLOR FORK ROAD REHABILITATION PROJECT*

CRABS Document Number: GA 1 3340

Township: 09S Range: 04E Section: 11

JACKMAN JANET A.

11/23/1992 *BIG SKY SNOWMOBILE TRAIL CONSTRUCTION*

CRABS Document Number: GA 1 14451

Township: 09S Range: 04E Section: 11

BAILEY MARILYN

9/14/1981 *CULTURAL RESOURCE REPORT TAYLOR FORK BURIED TELEPHONE LINE*

CRABS Document Number: GA 1 3271

Township: 09S Range: 04E Section: 11

RYAN J. MICHAEL

3/13/1987 *TAYLOR FORK ROAD REHABILITATION PROJECT*

CRABS Document Number: GA 1 3340

Township: 09S Range: 04E Section: 11

ALLEN WALTER E.

10/ /1988 *TAYLOR FORK - GALLATIN RIVER CONFLUENCE AREA SURVEY*

CRABS Document Number: GA 1 3375

Township: 09S Range: 04E Section: 11

LAHREN LARRY A.

7/ /1976 *SURFACE RECONNAISSANCE, INVESTIGATION AND EVALUATION OF CULTURAL RESOURCES ON PROPOSED IMPACT TRACTS OF FOREST SERVICE LAND IN THE BIG TIMBER, GALLATIN, HEBGEN LAKE AND LIVINGSTON RANGER DISTRICTS*

CRABS Document Number: ZZ 1 10744

Appendix E:

Documentation of Smithsonian Records and National Historic Registry Status

The following table lists the official Smithsonian site number designation, the estimated time period of each site, a brief description of the site type as known from survey records, the current land owner, and a statement of the current National Register status for each site cataloged within the proposed ORW reach. The "Time Period" designation presented here is only a general estimate of "Prehistoric" or "Historic" periods. Some sites are categorized to both time periods and some sites are listed as "no data." Note that further investigation of any sites may yield more information to refine or expand the time period of occupation or use.

The "Site Type" designation is a brief reference to the main cultural constituents recorded for each site. These include a range of historic sites from roads, trails, structures, houses, irrigation systems, ranger stations, lookouts, dude ranches, quarry and mining debris, and a camp constructed for the Civilian Conservation Corps (CCC). Prehistoric sites include lithic scatters, which include chipping debris and stone tools, possible rock shelters, fire hearths, tipi rings, and related material. For the purposes of this overview study, the transition from the prehistoric to the historic period may not be clearly reflected in the documented surface remains at any site. Some sites currently listed as "Prehistoric" may yield, through further in-depth study, more specific data pertaining to occupation and use.

The "National Register Status" listing for each site is a reflection of the information currently listed by the Montana State Historic Preservation Office (SHPO). The National Historic Preservation Act (36 CFR 800), and related regulations, establish guidelines for determining the integrity and significance of a cultural property. Additionally, the procedures establish a framework for determining if a site is eligible for listing on the National Register of Historic Places. Most of the sites summarized in this study are listed as "Undetermined" indicating that no formal determination has been made regarding the property's eligibility for listing. If a site's status is listed as "Unresolved" then either a recommendation has been made with no concurrence from the SHPO, or not enough information is available to complete a determination. Properties noted with "Ntl. Register Listed" are those that have been documented with a National Register nomination form and formally listed on the register. The entries for "Consensus Determined" are those cultural properties that have been recommended for nomination with full concurrence from the SHPO, but without subsequent formal listing on the National Register.

Table D.1. Table of recorded cultural resources within Gallatin River proposed ORW designation study area.

Smithsonian Site No.	Time Period[a]	Site Type	Owner[b]	National Register Status
24GA0021	H	Lookout	USFS	Undetermined
24GA0033	P	Lithic scatter	USFS	Undetermined
24GA0102	P	Lithic scatter, tipi ring	USFS	Undetermined
24GA0103	P	Lithic scatter	USFS	Undetermined
24GA0160	P	Lithic scatter	USFS	Undetermined
24GA0161	P	Lithic scatter	USFS	Undetermined
24GA0162	P	Lithic scatter	USFS	Undetermined
24GA0211	P	Fire hearths, lithic scatter	USFS	Undetermined
24GA0312	P	Lithic scatter	USFS, MDT	Undetermined

Smithsonian Site No.	Time Period[a]	Site Type	Owner[b]	National Register Status
24GA0317	P	Lithic scatter	MDT, other	Undetermined
24GA0318	P	Lithic scatter	No data	Undetermined
24GA0319	P	Lithic scatter	No data	Undetermined
24GA0320	no data	‘other’	MDT, other	Undetermined
24GA0322	P	Lithic scatter	No data	Undetermined
24GA0323	P	Lithic scatter	Private	Undetermined
24GA0324	no data	‘other’	MDT, other	Undetermined
24GA0337	H	Historic structure/site	USFS	Undetermined
24GA0389	H	Historic irrigation system	USFS	Undetermined
24GA0396	P	Lithic scatter	USFS	Undetermined
24GA0413	P	Lithic scatter	USFS	Undetermined
24GA0414	P	Lithic scatter	USFS	Undetermined
24GA0454	P	Lithic scatter	USFS	Undetermined
24GA0458	P	Rock shelter	National Wildlife Refuge	Undetermined
24GA0477	P,H	Paleo-point isolate, historic quarry	USFS	Consensus determination
24GA0478	H	Historic dude ranch	USFS	Undetermined
24GA0637	H	Historic log structure	Private	Undetermined
24GA0656	P	Lithic scatter	State	Undetermined
24GA0661	P	Lithic scatter	USFS	Undetermined
24GA0689	P	Lithic scatter	Private	Undetermined
24GA0690	P	Lithic scatter	USFS	Undetermined
24GA0692	P	Lithic scatter	USFS	Undetermined
24GA0693	P	Lithic scatter	Private	Undetermined
24GA0716	H	Historic site	Private	Ntl. Register Listed
24GA0788	H	Historic ranger station, CCC camp	USFS	Undetermined
24GA0840	P,H	Historic ranger station, prehistoric	USFS	Consensus determination
24GA0843	P,H	Historic ranger station, prehistoric material	USFS	Undetermined
24GA0844	P,H	Historic ranger station, prehistoric material	USFS	Undetermined
24GA0872	P	Lithic Scatter	USFS	Undetermined
24GA0874	P	Lithic scatter	USFS	Undetermined
24GA0875	P	Lithic scatter	USFS	Undetermined
24GA0876	P	Lithic scatter	USFS	Undetermined
24GA0877	P	Lithic scatter	USFS	Undetermined
24GA0985	P	Lithic scatter	USFS	Undetermined
24GA0986	P	Lithic scatter	USFS	Undetermined
24GA0987	P	Lithic scatter	USFS	Undetermined

Smithsonian Site No.	Time Period[a]	Site Type	Owner[b]	National Register Status
24GA0989	P	Lithic scatter	USFS	Undetermined
24GA0990	P	Lithic quarry	USFS	Undetermined
24GA1001	no data	no data	Private	Undetermined
24GA1002	P	Lithic scatter	Private	Undetermined
24GA1003	P	Lithic scatter	Private	Undetermined
24GA1004	P	Lithic scatter	Private	Undetermined
24GA1042	P, H	Lithic scatter, homestead/farmstead	Private	Undetermined
24GA1043	P	Lithic scatter	Private	Undetermined
24GA1044	P	Lithic scatter	Private	Undetermined
24GA1045	P	Lithic scatter	Private	Undetermined
24GA1046	P	Lithic scatter	Private	Undetermined
24GA1047	P	Lithic scatter	Private	Undetermined
24GA1048	P	Lithic scatter	Private	Undetermined
24GA1052	P	Lithic scatter	Private	Undetermined
24GA1053	P	Lithic scatter	Private	Undetermined
24GA1064	P	Lithic scatter	State	Undetermined
24GA1071	H	Historic bridge	Private	Undetermined
24GA1072	P	Lithic scatter	National Wildlife Refuge	Undetermined
24GA1076	P	Lithic scatter	Private	Undetermined
24GA1093	H	Historic road/trail	USFS	Undetermined
24GA1097	H	Historic mining	State, other	Undetermined
24GA1130	P	Lithic scatter	Private	Undetermined
24GA1134	P, H	Lithic scatter and historic log structure	Private	Undetermined
24GA1135	H	Historic log structure	Private	Undetermined
24GA1143	P	Lithic scatter	Private	Undetermined
24GA1155	P	Lithic scatter	USFS	Undetermined
24GA1156	no data	Lookout	Private	Undetermined
24GA1157	P	Lithic scatter	USFS	Undetermined
24GA1160	P	Lithic scatter	MDT, other	Undetermined
24GA1162	P	Lithic scatter	Private	Undetermined
24GA1181	P,H	Lithics, lookout	Combination	Undetermined
24GA1199	P	Lithic scatter	USFS	Undetermined
24GA1200	P	Lithic scatter	USFS	Undetermined
24GA1201	P	Lithic scatter	USFS	Undetermined
24GA1203	P	Lithic scatter	USFS	Undetermined
24GA1211	P	Lithic scatter	Private	Undetermined
24GA1213	P	Lithic scatter, tipi ring	USFS	Undetermined
24GA1344	H	Historic road/trail	USFS	Undetermined
24GA1357	H	Historic road/trail	USFS	Undetermined
24GA1360	H	Historic road/trail	USFS	Undetermined

Smithsonian Site No.	Time Period[a]	Site Type	Owner[b]	National Register Status
24GA1363	H	Historic road/trail	USFS	Undetermined
24GA1365	H	Historic road/trail	USFS	Undetermined
24GA1366	H	Historic road/trail	USFS	Undetermined
24GA1370	P,H	Historic road/trail, prehistoric	USFS	Undetermined
24GA1371	H	Historic road/trail	USFS	Undetermined
24GA1381	P	Lithic scatter	USFS	Undetermined
24GA1508	H	Historic bridge	MDT	Undetermined
24GA1511	H	Historic bridge	MDT	Undetermined
24GA1528	P	Lithic scatter	No data	Undetermined
24GA1548	H	Historic log structure	No data	Undetermined
24GA1549	P	Lithic scatter	No data	Undetermined
24GA1550	P	Lithic scatter	No data	Undetermined
24MA2033	H	Historic log structure, outbuildings	BLM	Undetermined
24MA2038	H	Historic mining debris	BLM	Undetermined
24MA2129	H	Historic irrigation system	Private	Unresolved

[a]Potential general time periods: P=prehistoric, H=historic,
[b]Ownership: BLM=Bureau of Land Management, USFS=Forest Service, MDT=Montana Department of Transportation

Appendix F:

Rationale and Explanation for Final Aquifer Vulnerability Footprint Map, Gallatin Outstanding Resource Water EIS

June 14, 2006

Prepared by: Tom Osborne and Shane Bofto
Re: Rationale and Explanation for Final Aquifer Vulnerability Footprint Map, Gallatin Outstanding Resource Water EIS

A draft Technical Memorandum on this topic was distributed January 18, 2006 for review and comment by the GANDA Gallatin River Outstanding Resource Water (ORW) EIS project team and the Montana Department of Environmental Quality (DEQ). Comments were received on January 26, 2006 from Eric Regensberger of the DEQ. This memorandum provides documentation of the procedures used to evaluate the Gallatin River Aquifer Vulnerability Footprint Map for the Draft EIS, and incorporates the edits and suggestions received.

HydroSolutions performed an aquifer vulnerability assessment and prepared a vulnerability "footprint" map in support of the Draft Gallatin River ORW EIS. The descriptor, "footprint", was used because the shallow groundwater system has a direct hydraulic connection to the Gallatin River within this area, and because DEQ would likely apply nondegradation review of water quality to subdivision development within this area. In addition, other activities subject to water quality permitting and nondegradation rules could also be reviewed by DEQ.

This Technical Memo is a summary of the background and rationale used to evaluate the hydrogeology along the Gallatin River and to identify areas where the shallow aquifers are in direct hydraulic communication with the Gallatin River or principal tributaries to the Gallatin within the study area, and therefore are likely to transmit contaminants to the river. The main goal of this study is to apply standard hydrogeologic methods and utilize existing information to produce scientifically defensible analyses and interpretations suitable for the policy and management objectives of the DEQ.

Groundwater vulnerability to contamination was defined by the National Research Council (Focazio et al. 2000) as "the tendency or likelihood for contaminants to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer." In the context of the Gallatin River ORW assessment, the "specified position in the groundwater system" of most interest is anywhere that groundwater will likely discharge to the river; that is, where groundwater is in direct hydrologic connection with the river. We performed a type of vulnerability study which is termed an "aquifer-sensitivity" or "intrinsic-susceptibility" assessment. This measure of the relative ease with which water enters and moves through an aquifer is a characteristic of the aquifer and overlying material and hydrologic conditions, and is independent of the chemical characteristics of the contaminant and its sources (Focazio et al. 2000).

This study began with the review of hydrologic and geologic publications, literature, and data which specifically targeted the Gallatin River watershed, and provided examples of analogous vulnerability assessments conducted elsewhere, or were appropriate references for this work.

Based on this review, the methodology developed for the vulnerability assessment is a hybrid of a “subjective rating method” and a “process-based method”. Subjective methods produce categories of vulnerability (usually high, medium and low) that are targeted for use by agencies to achieve policy or management objectives. Process methods apply scientific methods or models to calculate the distribution of vulnerability based on movement of water and solutes. This method often requires further interpretation prior to use by agencies and others.

This vulnerability assessment stems from a previous study by David O. Baldwin, whose 1997 Masters thesis was “Aquifer Vulnerability Assessment of the Big Sky Area, Montana” Department of Geological Engineering, Montana Tech of the University of Montana. This study was an assessment of the intrinsic vulnerability of local aquifers at Big Sky, Montana. A Geographical Information System (GIS) was used as a platform to analyze the data and publish vulnerability maps. Baldwin’s work was, in part, funded by the Montana DEQ. Baldwin authored a second report for DEQ entitled “Hydrogeologic and Hydrochemical Investigation of the Big Sky Area” (Baldwin 1996). This report is a baseline hydrogeologic and water quality evaluation of aquifers in the Big Sky area.

The Baldwin studies included only the watershed of the West Fork of the Gallatin River. However, most of the rock units and aquifers assessed in that study are also found throughout the study area for the Gallatin River ORW EIS. Subsequent to the Baldwin studies, a geologic map of the Ennis 30º x 60º Quadrangle was completed by the U.S. Geological Survey (Kellog and Williams, 2000). This assessment used the USGS rock classification system and made appropriate translations from Baldwin’s rock categories where variations occurred based on geologic age, lithology and map positions. The assignments of aquifer vulnerability classes and correlation with Baldwin’s study are summarized in Table F-1. Where geologic units were not specifically categorized by Baldwin, the vulnerability rating was assigned on the basis of estimated aquifer characteristics inferred from lithology, field inspection and experience.

The vulnerability criteria in the Baldwin studies (Baldwin, 1996; 1997) were:

- Aquifer characteristics
- Soil media
- Depth to groundwater, and
- Geologic units comprising the vadose zone.

Baldwin assigned vulnerability rankings to geologic units based on estimates of saturated hydraulic conductivity (K). To estimate groundwater velocities HydroSolutions used values of hydraulic conductivity and hydraulic gradient from Baldwin and from engineering studies conducted for subdivisions in the Big Sky area (Morrison-Maierle 1997, 2005), along with effective porosity information from published sources. Aquifers with rapid groundwater velocities result in a more direct hydraulic connection with the Gallatin River, and the zone of direct connection extends a greater distance from the river. The best estimate of the average linear velocity of groundwater in each type of aquifer was determined, and the corresponding distance of groundwater travel in one year (1-Year Time of Travel, or 1-Year TOT) was determined as indicated in Table F-2. The 1-Year Time of Travel distance from the edge of the

Gallatin River for each aquifer type was used as one of the setback criteria in the vulnerability footprint map. The 1-year TOT is selected as criteria because of the following:

- It is a well established basis for aquifer vulnerability assessments (Focazio et al. 2000)
- It is already used by other DEQ programs such as Wellhead Protection
- A TOT less than one year provides little opportunity for dilution and attenuation of contaminants
- TOT may be estimated with limited hydrogeologic data, and
- TOT may be verified by hydrogeologic testing which is often already performed in the planning stages of subdivisions and other significant land developments.

The distribution of the geologic units along the Gallatin River ORW study area into aquifer vulnerability categories (high, moderate and low) based on this evaluation is provided in Table F-3. Highly-vulnerable aquifers have a relative high inherent potential for contaminant transport to the Gallatin River, while low-vulnerability aquifers have relatively low inherent contaminant-transport potential, based on the best estimates of groundwater velocities from available information.

The vulnerability footprint map was produced by applying the criteria and classifications shown in Tables F-1, F-2 and F-3 with other criteria from studies by Baldwin (1997) and Woessner et al. (1996), including depth to groundwater, mapped septic system plume length, and whether the aquifer is confined or unconfined. The resulting footprint map guidelines and setback distances established for each category of aquifer vulnerability are summarized in Table F-4.

The procedure for mapping the extent of the aquifer vulnerability footprint is as follows:

- The one-year TOT setback as shown in Table F-4 was applied to each geologic unit in contact with the river, where that unit was likely to be unconfined by other low permeability rock units.

- The West Fork and its tributaries were mapped in general conformance to the criteria applied by Baldwin (1997); other tributaries were mapped from their confluence with the Gallatin River mainstem to the most upstream extent of high vulnerability units in direct contact with the mapped blue line depicting that tributary.

- The setback distances in the first row of Table F-4 were applied from the outermost banks of the Gallatin River or tributaries, as determined on 1:24,000 scale base maps.

- Setback distances were modified where: a) topographic contour lines indicated the land surface was 40 feet or greater above river elevation (indicating that the depth to groundwater at that point was probably 25 feet or greater), except that the minimum setback distance was 300 feet.

- A minimum setback was applied to the Madison Group everywhere, regardless of elevation, due to potential for karst conditions and known springs that discharge to the

Gallatin River. This distance was not less than the shorter of: a) ½-mile; b) the ridge top of Madison Group closest to the river; or c) a change to another geologic unit.

The "40 foot elevation above river level modification" was derived from Baldwin's "high" vulnerability criteria of 25 feet or less to the water table. Using the water table gradient maps in Baldwin (1997), it was estimated that when the land surface elevation is 40 feet or greater above the river, the depth to the water table is likely to be at least 25 feet. The existing U.S. Geological Survey topographic maps use 40-foot topographic contour intervals, thus allowing for reasonably-accurate interpolations of the 40-foot elevation criteria in creating the vulnerability footprint map.

The minimum of a 300-foot setback from the river was obtained from studies of septic system plumes conducted by University of Montana hydrogeology Professor William Woessner, and his students (Woessner et al. 1996). These studies were conducted in shallow groundwater settings near Missoula, which may not differ greatly from the Gallatin River valley. Their studies indicated that contaminants from residential septic systems could be measured in the aquifer at distances over 200 feet from the source. A Masters of Science degree report by Boer (2002), also of The University of Montana Department of Geology, evaluated sources of nitrate contamination to shallow groundwater near Lolo, Montana. He found concentrations of nitrate down-gradient of un-sewered subdivisions were commonly above 2.5 mg/L and reached 4.6 mg/L. He reported that nitrate-contaminated groundwater discharged directly to the Bitterroot River, and could potentially exceed the 0.010 mg/L trigger for non-degradation review.

The Madison Group aquifer is karstic, meaning it has large solution cavities and interconnected openings. Studies by Montana State University student John Schaffer, under the direction of Earth Science Professor Steven Custer, demonstrated that the Madison aquifer discharges about 70 cubic feet per second (cfs) of groundwater year-round to the Gallatin River near Big Sky. This discharge occurs in a series of springs which are visible along the Gallatin River both above and below the confluence with the West Fork. Snowflake Springs, just north of the Yellowstone National Park boundary, also visibly discharges a large quantity of groundwater directly to the Gallatin River. Groundwater can travel long distances in short times in karst aquifers, with little attenuation of contaminants. The setback distance was based on the shorter of the 1-Year TOT (1/2-mile), the distance to the closest ridge top from the Gallatin River, or a change to another geologic unit.

HydroSolutions applied the above methodology by computer-aided mapping in an ArcGIS environment. A GIS specialist magnified successive portions of the study area, and drew the outline of the vulnerability footprint area according to the above criteria. The outline was checked by an experienced hydrogeologist.

All contamination rating systems of this kind have limitations. Limitations of this method, include, but are not limited to the following:

- The vulnerability footprint map is based on existing information. Field studies were not conducted specifically for this evaluation.

- Hydrogeologic data from Baldwin (1997) are limited and may not represent the full range of parameters found in the geologic units along the mainstem of the Gallatin River.

- Hydrogeologic characteristics vary substantially even within specific geologic units and the calculated setback distances vary with the parameters used in the calculations. The available hydrogeologic information was not sufficient to perform sensitivity analysis.

- The scales of the geologic maps and topographic maps limit the accuracy of the line used to define the vulnerability footprint area.

- It was assumed that the Gallatin River and its tributaries are ~~a~~ "gaining" stream system, that is, groundwater discharges to the river. In places it is possible that the river discharges to the groundwater system, although evidence of this type of discharge was not found.

- Attenuation of contaminants is not specifically considered in developing the footprint map, since contaminants vary markedly with respect to attenuation mechanisms. The footprint map is consistent with advective groundwater transport of conservative contaminants.

References:

Baldwin, D.O. 1997. Aquifer Vulnerability Assessment of the Big Sky Area, Montana. Masters Thesis, Department of Geological Engineering, Montana Tech of the University of Montana, Butte, MT.

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Table F-1. Geologic Unit Classifications.

Geologic Symbol	Description of Geologic Units in Footprint	Vulnerability Class #	Baldwin's Class	Relative Groundwater Velocity
Qal	Alluvium	3	3	High
Ql	Landslide deposits	1	1	Low
Qcl	Colluvium and loess	2	NA	Moderate
Qg	Terrace-gravel deposits	3	NA	High
Qti	Till	1	1	Low
Ku	Everts Fm., Virgelle Sandstone, Telegraph Creek Fm., Cody Shale, Frontier Fm., and Mowry Shale	2	2	Moderate
Kmo	Mowry Shale	2	2	Moderate
Kmt	Muddy Sandstone and Thermopolis Shale	3	3	High
Kk	Kootenai Fm.	3	3	High
Jm	Morrison Fm.	2	2	Moderate
JTru	Morrison Fm., Ellis Group, and Woodside Siltstone and Dinwoody Fm.	2	2	Moderate
Ps	Shedhorn Sandstone	3	3	High
Pmqa	Quadrand Sandstone, Amsden Group, and Snowcrest Range Group	3	3	High
Mm	Madison Group	3	3	High
MDtj	Three Forks Fm., and Jefferson Fm.	2	2	Moderate
Cmi	Park Shale, Meagher Limestone, Wolsey Fm., and Flathead Sandstone	2	NA	Moderate
Agp	Granite porphyry of Hell Roaring Creek	1	NA	Low
Agg	Granitic orthogneiss	1	NA	Low
Aqf	Quartzofeldspathic gneiss	1	NA	Low
Aam	Hornblende-plagioclase gneiss and amphibolite	1	NA	Low
Abs	Biotite shist	1	NA	Low
Abh	Biotite-hornblende gneiss of Beartrap Canyon	1	NA	Low

Geologic unit symbols and description from Kellog and Williams (2000).
Aquifer Vulnerability Ranking: 3 – Highest, 2 – Moderate, 3 – Lowest vulnerability (Baldwin, 1997).
NA – Classification by Baldwin (1997) not available; classified based on lithology, field inspection and experience.
Relative groundwater velocity based on calculations in TableF-2.

Table F-2. Groundwater Velocity and One-Year Time Of Travel Distance Calculations.

				Information Sources
High Velocity Unconsolidated Units				
Hydraulic Conductivity	K	1115	ft/d	Pumping Test of Ramshorn Subdivision #T-2 Well (Morrison-Maierle 1997)
Gradient	i	0.0125	ft/ft	Determination of Significance for Ramshorn Subdivision (DEQ 1998)
Effective Porosity	n	0.25		Coarse-Medium Gravel (Walton 1996)
Average Linear Groundwater Velocity	V	55.75	ft/d	
1 Year Travel Distance		20349	ft	
High Velocity Sedimentary Units				
Hydraulic Conductivity	K	1136	ft/d	Pumping Test of Well RR#4, Rimrock Subdivision (Morrison-Maierle 2005)
Gradient	i	0.00125	ft/ft	Rimrock Subdivision Aquifer Test Results (Morrison-Maierle 2005)
Effective Porosity	n	0.2		Fracture storage plus matrix storage (Freeze and Cherry 1979)
Average Linear Groundwater Velocity	V	7.10	ft/d	
1 Year Travel Distance		2592	ft	
Moderate Velocity Sedimentary Units				
Hydraulic Conductivity	K	3.16	ft/d	Geomean of K for "Moderate" conductivity units (Baldwin 1997)
Gradient	i	0.086	ft/ft	Fractured rock gradient (Baldwin 1997)
Effective Porosity	n	0.05		Fractured shale (Freeze and Cherry 1979)
Average Linear Groundwater Velocity	V	5.44	ft/d	
1 Year Travel Distance		1985	ft	
Low Velocity Units				
Hydraulic Conductivity	K	1	ft/d	Average K for "Low" conductivity unit (Baldwin 1997)
Gradient	i	0.086	ft/ft	Fractured rock gradient (Baldwin 1997)
Effective Porosity	n	0.025		Mid-range of fractured crystalline rocks (Freeze and Cherry 1979)
Average Linear Groundwater Velocity	V	3.44	ft/d	
1 Year Travel Distance		1256	ft	

Average Linear Groundwater Velocity (V) = (Ki)/n.

Table F-3. Aquifer Vulnerability Assessment And Footprint Map Guidelines For Gallatin River Outstanding Resource Water Draft EIS.

Highly Vulnerable Unconsolidated Units (high groundwater velocity)	**Highly Vulnerable Bedrock Units** (high groundwater velocity)	**Moderately Vulnerable Geologic Units** (moderate groundwater velocity)	**Low Vulnerability Geologic Units** (low groundwater velocity)
Rank: 3 [a]	**Rank: 3**	**Rank: 2**	**Rank: 1**
Qal- Alluvium [b]	Kmt- Muddy Sandstone and Thermopolis Shale	Qcl- Colluvium and loess	Ql- Landslide deposits
Qg- Terrace-gravel deposits	Kk- Kootenai Fm.	Ku- Everts Fm., Virgelle Sandstone, Telegraph Creek Fm., Cody Shale, Frontier Fm., and Mowry Shale	Qti- Till
	Ps- Shedhorn Sandstone	Kmo- Mowry Shale	Agp- Granite porphyry of Hell Roaring Creek
	Pmqa- Quadrand Sandstone, Amsden Group, and Snowcrest Range Group	Jm- Morrison Fm.	Agg- Granitic orthogneiss
	Mm- Madison Group	Jtru- Morrison Fm., Ellis Group, and Woodside Siltstone and Dinwoody Fm.	Aqf- Quartzofeldspathic gneiss
		MDtj- Three Forks Fm., and Jefferson Fm.	Aam- Hornblende-plagioclase gneiss and amphibolite
		Cmi- Park Shale, Meagher Limestone, Wolsey Fm., and Flathead Sandstone	Abs- Biotite shist
			Abh- Biotite-hornblende gneiss of Beartrap Canyon

[a] Ranking of relative aquifer vulnerability (3 = highest vulnerability) adapted from Baldwin (1997) with interpretations for additional units based on estimated aquifer properties.
[b] Geologic unit names and abbreviations taken from 1:100000 scale geologic map (Kellog and Williams 2000).

Table F-4. Setback Criteria For Potential Contaminant Sources From Mainstem Of Gallatin River And Perennial Tributaries By Characteristics Of The Uppermost Aquifer

Highly Vulnerable Coarse-Grained Units (high groundwater velocity)	**Highly Vulnerable Geologic Units** (high groundwater velocity)	**Moderately Vulnerable Geologic Units** (moderate groundwater velocity)	**Low Vulnerability Geologic Units** (lower groundwater velocity)
Rank: 3	**Rank: 3**	**Rank: 2**	**Rank: 1**
Full extent of continuous deposit in contact with Gallatin River or tributaries (1-Year TOT is greater than 1 mile) [a].	A setback of ½-mile (2640 feet) [a] where the aquifer is unconfined, or	A setback of 2000 feet [a] where the aquifer is unconfined, or	A setback of ¼-mile (1320 feet) [a] where the aquifer is unconfined, or
	A setback from the Gallatin River or tributaries where land surface is 40 [b] feet or greater above average river elevation in the shortest linear direction.	A setback from the Gallatin River or tributaries where land surface is 40 [b] feet or greater above average river elevation in the shortest linear direction.	A setback from the Gallatin River or tributaries where land surface is 40 [b] feet or greater above average river elevation in the shortest linear direction.
	except, that the minimum setback shall not be less than 300 feet;	except, that the minimum setback shall not be less than 300 feet;	except, that the minimum setback shall not be less than 300 feet;
	except, if bedrock aquifer is shown to be confined, the minimum setback of 300 feet [c] applies.	except, if bedrock aquifer is shown to be confined, the minimum setback of 300 feet [c] applies.	except, if bedrock aquifer is shown to be confined, the minimum setback of 300 feet [c] applies.
	except, the minimum setback for Madison Group (Mm) shall not be less than the shorter of ½-mile, the Madison ridge top closest to the river, or a change in geologic unit.		

[a] Setback distance based on One-Year Time of Travel distance calculated from best available data.
[b] 40-foot elevation difference results in estimated 25-feet or more above the water table; criteria from Baldwin (1997).
[c] 300-foot setback distance interpreted from septic system plume studies by Woessner et al. (1996).

Appendix G:

Wastewater Treatment Systems Evaluation and Comparison

PREPARED BY: ERIC DETMER, PE

SUBJECT: TREATMENT SYSTEM EVALUATION, GALLATIN ORW PROJECT

DATE: APRIL 18, 2006

An evaluation of residential septic treatment systems was performed for the purpose of identifying ranges of treatment capabilities, costs and installation/operational constraints. Two types of treatment efficiencies were evaluated, potential nitrogen (N) removal and phosphorous (P) removal; N and P were defined as the limiting constituents in a previous nondegradation nutrient loading analysis for the project area, therefore, they were the only parameters of interest for this analysis. Next, capital and operations/maintenance costs were evaluated, and a 30-year net-present-value was then calculated to provide a means for comparison among systems with high up-front costs (and low maintenance costs) versus systems with high long-term maintenance costs (and low up-front costs). Costs were gathered from a mix of published sources, cost estimating manuals (e.g., R.S. Means), vendor quotes and engineering estimates. Finally, installation and operating constraints were evaluated for each treatment system.

Table G-1 on the following pages summarizes the results of the evaluation. A number of subsurface wastewater treatment systems (SWTS) were evaluated and include:

- Conventional septic system with gravity drainfield (for use as a baseline);
- Conventional septic system with pressurized drainfield distribution (additional baseline);
- Recirculating sand filter;
- Recirculating textile filter;
- Trickling filter;
- Sequencing batch reactor;
- Aerobic system;
- Intermittent sand filter / elevated mound system;
- Incinerator toilets (blackwater diversion);
- Composting toilets (blackwater diversion); and
- Chemical precipitation for phosphorous removal.

Finally, each system was compared with Montana Department of Environmental Quality's list of approved nitrogen-reducing treatment systems (farthest right column in Table G-1). If the system is not approved, the SWTS would need to be evaluated for nitrogen-reducing (or phosphorous-reducing) designation; this process typically takes 60-day.

Table G-1. Treatment System Evaluation, Gallatin ORW Project

Treatment Type	Description	Typical Nitrogen (N) Removal	Typical Phosphorous (P) Removal	Capital Costs (includes installation)	Operations and Maintenance (O&M) Costs	NPV (30 years, 8% ROR)	Cost Basis	Constraints	DEQ Nitrogen-Reducing System Status [ARM 17.30.702(9)(10) and (11)]
Baseline Septic System									
Traditional Septic Tank and Gravity-Fed Absorption Drain Field	Septic tank with adjacent drain field	Typically removes about 25% of total nitrogen (Metcalf & Eddy 1991). DEQ estimates 17%.	9% (Etnier et al. 2005)	Highly variable, engineer cost estimate of $6,000 used.	$531 per septic tank pump trip	$6,761	O&M (Scenic City Pumping vendor quote), recommend pumping 1,500 gallon tank every 4 years.	The traditional decentralized wastewater treatment system of choice. Passive system with no power requirements. Septage removal usually requires professional services, but these are readily available in the project area.	None
Traditional Septic Tank with Pressurized Distribution System	Septic tank with adjacent pump-supplied drain field	Typically removes about 25% of total nitrogen (Metcalf & Eddy 1991). DEQ estimates 17%.	9% (Etnier et al. 2005)	Highly variable, engineer cost estimate of $7,000 used.	$531 per septic tank pump trip	$8,711	O&M (Scenic City Pumping vendor quote), recommend pumping 1,500 gallon tank every 4 years. Estimate $100 per year for power associated with pump.	The traditional decentralized wastewater treatment system of choice. Passive system with limited power requirements for pressurized dosing of the drain field. Septage removal usually requires professional services, but these are readily available in the project area. Pump may require maintenance and/or replacement.	None
Alternative Subsurface Wastewater Treatment Systems									
Recirculating Sand Filter	Aerobic, fixed-film bioreactor. System is an add-on to a traditional septic tank and drain field. Consists of a lined excavation filled with uniform washed sand that is placed over an underdrain system. The wastewater is dosed onto the surface of the sand through a distribution network and allowed to percolate through the sand to the underdrain system. The underdrain system collects and recycles the filter effluent to a	45-75% (EPA 2002).	Phosphorus removal drops off from high percentages to about 20 to 30 percent after the exchange capacity of the media becomes exhausted. Some media and media mixes have very high iron and/or aluminum content that extends	$8,000 to $11,000 (EPA 2002) for sand filter. $6,000 for septic system and drain field.	Annual power cost of $90-120/year plus inspection/management costs of between $150-200/year (EPA 2002). Septic tank requires pump out every 4 years.	$17,033 to $19,811	EPA 2002 for capital costs and power/mgmt O&M costs. Scenic City Pumping (Bozeman, MT) vendor quote for septic tank pumping (1,500 gallons every 4 years).	Requires careful construction techniques. System requires electric power; power outages will stop the process from treating the wastewater, and prolonged outages would be likely to generate some odors. Inspection and operation/maintenance needs are primarily related to inspection and calibration of the recirculation pump and controls. For sand media units, frequent removal of vegetation and scraping of the surface are	Level 2 (no specific model/manufacturer listed)

Table G-1. Treatment System Evaluation, Gallatin ORW Project

Treatment Type	Description	Typical Nitrogen (N) Removal	Typical Phosphorous (P) Removal	Capital Costs (includes installation)	Operations and Maintenance (O&M) Costs	NPV (30 years, 8% ROR)	Cost Basis	Constraints	DEQ Nitrogen-Reducing System Status [ARM 17.30.702(9)(10) and (11)]
	recirculation tank for further processing or discharge (EPA 2002).		the initial period of high phosphorus removal (EPA 2002).					required.	
Recirculating Trickling/ Textile Filter	System is in add-on to a traditional septic tank and drain field. Effluent in septic tank is pumped through textile filter then back to septic tank and gravity fed or pumped to drain field.	Removes at least 60% of total nitrogen (effluent conc. = 24 mg/L or less) (DEQ 2005).	Manufacturer reports that system is not designed for phosphorus removal, though some amount is removed during treatment (Orenco 2006).	$12,000 to $18,000 (Anderson 2006). Price includes septic system and drain field. Price includes first two years O&M.	Assume power of $300 per year. $450 per year for O&M contract after first two years (Anderson 2006).	$18,400 to $23,955	For capital and O&M costs, vendor quote (Anderson 2006).	More mechanically complex than traditional systems. System requires electric power.	Level 2 (Orenco's AdvanTex® listed)
Recirculating Trickling Filter [NOTE: DEQ considers this system and one above as Recirculating Trickling Filters.]	System is an add-on to a traditional septic tank and drain field. Effluent in septic tank is pumped through trickling filter (inside 1,250 gallon tank) then gravity fed back to septic tank, then pumped to drain field.	Removes approximately 70% of total N (Cotton 2006).	10-15% (EPA 2002).	$9,000 for Fluidyne™ (includes maintenance contract for first two years), plus cost of septic tank and drain field (assume as $6,000).	$100 per year for power (EPA 2002) and $500 per year for required maintenance contract (Cotton 2006). $531 every 4 years for septic tank pump out.	$20,902	Vendor quote for Fluidyne™ (Cotton 2006) and engineer's estimate (using published cost data) for septic tank and drain field installation.	More mechanically complex than traditional systems. System requires electric power. Can be susceptible to extreme cold. A prolonged interruption of electric supply will result in odors. Filter flies may also be a nuisance with these systems if vents are not properly screened (EPA 2002).	Level 2 (Fluidyne's Eliminite™ listed)

Table G-1. Treatment System Evaluation, Gallatin ORW Project

Treatment Type	Description	Typical Nitrogen (N) Removal	Typical Phosphorous (P) Removal	Capital Costs (includes installation)	Operations and Maintenance (O&M) Costs	NPV (30 years, 8% ROR)	Cost Basis	Constraints	DEQ Nitrogen-Reducing System Status [ARM 17.30.702(9)(10) and (11)]
Sequencing Batch Reactor (SBR)	System is an add-on to a traditional septic tank (for pre-treatment) and drain field. Wastewater is pumped from the septic tank to the SBR. The SBR cycle is five hours long and consists of three hours aeration, sedimentation for 90 minutes, and emptying for 30 minutes. The effluent continues to the soil absorption system, and the excess sludge is sent to one of two sludge filter bags (used alternately), where it is dried by air blown through it. When the activated sludge chamber is between cycles, it is aerated 30 minutes every hour. Some sludge is recirculated as return sludge,	Varies widely depending on type of SBR. Ranges between 30-80% (Etnier et al. 2005).	Varies widely depending on type of SBR. Ranges 0-70% (Etnier et al. 2005).	$8,500 to $12,000 (EPA 2002) installed for single residential systems. $6,000 for septic system and drain field. One vendor quote indicated a cost of $3,500 to $4,500 per residence (includes septic tank and drain field), though not for sale to developments with less than 15 homes (IWS 2006).	$350 per year for electricity (Etnier et al. 2005), $400 per year for service contract (EPA 2002). $531 every 4 years to for septic tank pump out.	$22,306 to $25,546 based on single family residence. $12,583 for development with 15 or more residences.	For single family residence capital and O&M costs obtained from (EPA 2002). Vendor quote for multiple residence development costs obtained from (IWS 2006).	Not suitable for seasonal applications. Relatively high maintenance requirements. System requires electric power. Dried sludge requires removal and management (can be land applied in yard).	Level 2 (International Wastewater System's (IWS) Model 6000 listed)
Aerobic System	System is an add-on to a traditional septic tank (for pre-treatment) and drain field. Uses suspended growth processes. These units include a main compartment called an aeration chamber in which air is mixed with the wastewater. Air is typically forced into the aeration chamber by an air blower or through liquid agitation. Forced air mixes with wastewater in the aeration chamber, and the oxygen supports the growth of aerobic bacteria. Typically consists of an	15-25% (EPA 2002).	10-20% (EPA 2002).	$2,500 to $9,000 installed (EPA 2000).	$450 per year for power and $350 per year for required maintenance contract (EPA 2000). $531 every 4 years for septic tank pump out.	$17,262 to $23,280	Capital costs from (EPA 2000). Assumed 6.25 kW-h per day, $0.0906 per kW-h). Scenic City Pumping (Bozeman, MT) vendor quote for septic tank pumping (1,500 gallons every 4 years).	Increased annual cost from continuously running air supply. Requires routine maintenance. Subject to upsets under sudden heavy loads or when neglected	None

Table G-1. Treatment System Evaluation, Gallatin ORW Project

Treatment Type	Description	Typical Nitrogen (N) Removal	Typical Phosphorous (P) Removal	Capital Costs (includes installation)	Operations and Maintenance (O&M) Costs	NPV (30 years, 8% ROR)	Cost Basis	Constraints	DEQ Nitrogen-Reducing System Status [ARM 17.30.702(9)(10) and (11)]
	aeration basin and clarifier.								
Elevated Sand Mound / Intermittent Sand Filter (single pass)	Aerobic, fixed-film bioreactor. Provides advanced secondary treatment of settled wastewater or septic tank effluent. Consists of a lined excavation filled with uniform washed sand that is placed over an underdrain system (elevated mounds do not typically have impermeable liner under media). Wastewater is dosed onto the surface of the sand through a distribution network and allowed to percolate through the sand to the underdrain system. The underdrain system collects the filter effluent for further processing or discharge (EPA 2002).	18-33% (EPA 2002).	Phosphorus removal drops off from high percentages to about 20 to 30 percent after the exchange capacity of the media becomes exhausted. Some media and media mixes have very high iron and/or aluminum content that extends the initial period of high phosphorus removal (EPA 2002).	$4,000 for media filter installed (EPA 2002). $6,000 for septic system and drain field.	Annual power cost of $100/year plus inspection/management costs of between $150-200/year (EPA 2002). Septic tank requires pump out every 4 years.	$13,535	EPA 2002 for capital costs and power/mgmt O&M costs. Scenic City Pumping (Bozeman, MT) vendor quote for septic tank pumping (1,500 gallons every 4 years).	Mound systems typically installed in areas where high groundwater exists. Requires electric power; power outages will stop the process from treating the wastewater, and prolonged outages would be likely to generate some odors. Inspection and operation/maintenance needs are primarily related to inspection of the filter media and removal of undesirable vegetation. System should not be installed in surface depressions. Period raking (for ready-access types) is required to reduce clogging/ponding.	Intermittent Sand Filter is Level 1b (no model/manufacturer specified). Elevated Sand Mounds - none (removed from DEQ's approval list as of May 1, 2005).
Incinerator Toilets	Incinerator technology uses 1000ºF electric heat to reduce human waste (urine, solids, paper) to a small amount of clean ash, which is dumped periodically into the garbage.	Essentially serves as a form of blackwater diversion; would result in a 78% reduction in total nitrogen (EPA 2002). Remaining nitrogen in gray water would be	Essentially serves as a form of blackwater diversion; would result in a 59% reduction in phosphorous (EPA 2002). Remaining phosphorous in gray water would	$1,599 per toilet, $75 for shipping (Incinolet 2006).	Approximately $1,000 per year in power consumption. Approximately $400 per year for bowl liners. Also have to pump out septic tank	$20,086	Capital costs from (Etnier et al. 2005). Used half of traditional septic system cost (presumably reduced gray water size requirement). Assumed 15 flushes per day (2 kW-h	Requires significant change in user behavior due to use of bowl liners and frequent removal of ash (manufacturer reports ash can be disposed in trash). Would still require a traditional septic system (albeit smaller) to handle gray waters.	None

Table G-1. Treatment System Evaluation, Gallatin ORW Project

Treatment Type	Description	Typical Nitrogen (N) Removal	Typical Phosphorous (P) Removal	Capital Costs (includes installation)	Operations and Maintenance (O&M) Costs	NPV (30 years, 8% ROR)	Cost Basis	Constraints	DEQ Nitrogen-Reducing System Status [ARM 17.30.702(9)(10) and (11)]
		reduced by about 25% in septic tank (Metcalf & Eddy 1991).	be reduced by about 9% in septic tank (Etnier et al. 2005).		every 4 years ($531 per septic tank pump out).		per flush, $0.0906 per kW-h)		
Composting Toilets	Composting toilets empty waste into a bin or drum which is rotated every 2-3 days and emptied out periodically.	Essentially serves as a form of blackwater diversion; would result in a 78% reduction in total nitrogen (EPA 2002). Remaining nitrogen in gray water would be reduced by about 25% in septic tank (Metcalf & Eddy 1991).	Essentially serves as a form of blackwater diversion; would result in a 59% reduction in phosphorous (EPA 2002). Remaining phosphorous in gray water would be reduced by about 9% in septic tank (Etnier et al. 2005).	Between $1,600 and $6,400 (depending on model (Etnier et al. 2005).	Electricity for the exhaust fan is estimated to be $100 per year; also have to pump out septic tank every 4 years ($531 per septic tank pump out).	$6,488 to $10,932	Capital costs from (Etnier et al. 2005). Used half of traditional septic system cost (presumably reduced gray water size requirement). Also assumed septic tank still requires pump out every 4 years.	Would still require a traditional septic system (albeit smaller) to handle gray waters. Requires significant change in user behavior due to addition of bulking compounds, removal of compost, etc.	None
Chemical Removal of Phosphorous	Numerous types of chemical injection methods are available for nitrogen and phosphorous removal. Metal salts (including ferric chloride and aluminum sulfate [alum]) and lime are added either before the septic tank or after (with a second settling tank) to achieve phosphorous removal.	--	Using alum, 50-90% of total phosphorous can be removed (Etnier et al. 2005).	$2,400 for an alum injection system (Etnier 2005). Assume septic tank/drain field cost of $6,000.	Expect to pump sludge 2-3 times per year ($531 per septic tank pump out) and $535 per year for chemical (Etnier et al. 2005).	$26,840.89	Capital and O&M costs from (Etnier et al. 2005). Assumed septic tank pump out 2.5 times per year.	Chemical precipitation generates lots of sludge which must be managed by the homeowner. In addition, chemicals must be purchased and dosed into the system. Using metal salts (ferric chloride) requires the water to be at high pH levels which must also be monitored. Systems are maintenance intensive.	None

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Appendix H:

Geographic Information System Data Layer Processing Steps

GIS Process/Model Steps

Job Name: Gallatin River ORW EIS
GIS Analyst: Clint Kellar
Date(s): January through March 2006

Process Description: Calculating Acres by Land Use for the Land Use Analysis

Data layers used for the analysis:

- Ownership for Gallatin and Madison counties (source: NRIS [National Resource Information System], file date 1/24/2006).
- Gallatin Canyon/Big Sky and South Gallatin zoning districts (source: Gallatin County).
- Structures (source: Gallatin County).
- Big Sky Water and Sewer District Boundary (source: Big Sky Water and Sewer District).
- The Footprint showing the vulnerability zone (source: HydroSolutions Inc., version of footprint used was obtained on 2/15/2006).
- Stewardship – easement information (source: NRIS)
- Color aerial orthophotos, acquired during August 2005 (source: NRIS, National Agriculture Imagery Program [NAIP]).

1. A layer containing all parcels in the study area (the Upper Gallatin HUC [Hydrologic Unit Code]) was derived from the ownership layer. These parcels were attributed using information from the above layers. This included:
    a. Ownership class (private or public).
    b. The zoning classification based upon the respective district (if a parcel fell inside multiple zoning classes, it was divided in order to calculate the total acreage by zone. This was recommended by Paul Bussi, Gallatin County Planner).
    c. Presence of a conservation easement on the parcel.
    d. The number of structures within each parcel (excluding the following types: Garage, Cell Tower, Communications, Hazardous Materials Site, Other, and Water/Wastewater).
    e. Parcels falling within the Big Sky Water and Sewer District.
    f. Parcels falling within the vulnerability zone. This was determined by clipping the parcels with the footprint. The resulting parcel layer included only those portions of the parcel which were inside the footprint. Note that islands within the footprint were excluded from the calculation (confirmed with Dennis Elliot).
2. Using the attributes described above, a layer of all parcels to be used for the Land Use Analysis was created based upon:
    a. Private ownership.
    b. The total acreage of the portion of each parcel within the footprint. Note that any parcels which had less than 5% of their area within the footprint, of which was less than 0.1 acre, were not included in the layer. This was based on the assumption that these smaller parcels with a fraction of their area in the footprint would not be sources of impact.
    c. Parcels not falling within the Big Sky Water and Sewer District.
3. The land use analysis parcels were further attributed to define whether they were “Developed”, “Undeveloped/Vacant”, and “Partially Developed”. Because of

limitations in available data, the “Partially Developed” classification was only used within the Gallatin Canyon/Big Sky Zoning District. A combination of information was used to define developed status:

   a. The attributes described above in step 2 b, c, and d.
   b. Attributes in the ownership layer, including the following fields (and respective values):
      i. Respropind (Vacant, Dwelling, Other).
      ii. Combldgtype (Restaurant, Warehouse, etc.).
      iii. Tot_FB_Value (if a value was present here, it indicated that a residence may be present on the parcel).
   c. For residential land uses, a formula was used to calculate the potential for development based upon parcel size and zoning (note: this was recommended by Paul Bussi, Gallatin County Planner), where:
      Parcel Acreage / Zoning density = max units (residences) per parcel
      The result from this calculation was added to the attributes for each parcel coded with a residential land use value.
   d. Visual observation of parcel overlaid on top of the aerial photography.

4. The resulting attributes in the parcel layer were summarized using a combined field coded with land use, developed status, and zoning district. This table was used to populate the Land Use Analysis table.
   a. The development potential for partially developed parcels was determined by calculating the maximum number of dwellings based upon zoning and parcel size, then subtracting 1 to account for an existing dwelling.
   b. Resulting totals used for the Land Development table were rounded to the nearest number.

Notes:

- In some cases, the classification was based on the best judgment of the GIS analyst using the combination of data available.
- While using the aerial photography, the analyst could not distinguish between a residence and an outbuilding, thus it was assumed that any visible structure was a residence.
- Any recent development that was not recorded in the input data and dated later than the aerial photography would not be detected.
- Parcels coded as “Park/Open Space” or “Common Open Space” were categorized as developed, since it is assumed that no further development will occur on these parcels.
- Parcels zoned as CI (commercial and industrial mixed use) that were not vacant were categorized as “Developed” regardless of the number of structures within them (per recommendation by Paul Bussi, Gallatin County Planner, due to the wide range of uses and minimums allowed within this zone).
- For development status, the area of the parcel within the footprint was considered. An example would be if the portion outside of the footprint contained a structure, but the portion inside did not, and the potential for development allowed for an additional structure, that parcel was labeled as Undeveloped.
  - For the Spanish Fork area, a parcel was determined to be “developed” if a structure was present, regardless of size.

Processing Flow: